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VOLUME 4, No. 2 FEBRUARY 1952

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WORLD CROPS

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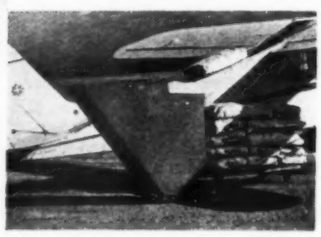

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Editorial Comment

The FAO Conference

THE recent FAO conference must be reckoned to be among the most important so far held. The number of leading statesmen and officials from member countries who attended and addressed the conference is proof, if any was needed, of the growing esteem in which FAO is held. Nevertheless, it is equally clear that, apart from a limited and select circle, there is still marked lack of appreciation and understanding of its aims and accomplishments in the world at large. It is remarkable, for example, what a small amount of publicity the conference received in the British Press and on the wireless, notwithstanding the important and far-reaching nature of many of the problems discussed. This is regrettable, since FAO has strong claims to be regarded as among the most important of the numerous agencies which operate under the UNO umbrella.

It is no doubt true that hitherto the organisation has failed adequately to publicise itself; this view found expression at the conference both in the remarks of its Director-General himself and also in a noteworthy statement by the Swiss delegation. The latter pointed out that, while there is conviction in many high quarters that FAO is doing valuable and effective work, farming communities throughout the world are either entirely ignorant of its existence or, at best, are only vaguely informed of its objects and aims. Oft-times, moreover, its value is minimised and its aims distorted.

This is a state of affairs which is greatly to be regretted. It is, or should be, obvious that not until the world public are adequately informed about FAO aims and objects can it hope to achieve the full measure of public support and recognition essential for the fulfilment of its aims.

The proposals agreed to at the conference that from the commencement of 1952 FAO should issue regularly monthly bulletins of information about the progress of its work in various spheres is therefore a welcome step in the right direction, while the issue of a popular but well documented outline of the basic importance of agriculture in the world economy, as proposed by the Swiss delegation, should also prove a useful step.

The financial resources of the organisation are limited, especially having regard to the magnitude of its programme and the wide field it is expected to cover. Actually, the annual budget of FAO only amounts to $5 million or, including the additional expenditure envisaged during the next two-year period, $5¼ million. It is not surprising that in these circumstances the amount which FAO has been able to provide for publicity regarding its own activities has been minimal, being given its other commitments. It is, however, not to be overlooked that omission to provide such expenditure may have far-reaching repercussions, since if the world is not kept informed of what FAO is doing it cannot be expected that public support and finance for its activities will be freely forthcoming.

One promising direction for increasing publicity seems to lie in committees which have been set up to provide liaison with governments, institutions and the general public in member states, since if these are adequately organised and efficiently operated they may be expected to provide a valuable measure of publicity for FAO activities.

British and American farming

THE lecture recently delivered by Mr. Elwyn Jones before the British Farmers' Club with the intriguing title, ' Can we learn from American Farmers?,' was provocative of an interesting and stimulating discussion. The paper was largely based upon the recently published report of the British Agricultural Productivity Team which visited the U.S.A. last summer and of which Mr. Elwyn Jones was a member.

The main point emerging from the paper and discussion was not so much what could be learnt from American farming as how far American methods were applicable to British conditions, and on this there seemed to be considerable divergence of opinion.

It was generally agreed that in America soil and climatic conditions favour the farmer, rotations are simpler, with silage taking the place of roots, field operations are simplified by good layout of fields and buildings, and that mechanisation is more closely co-ordinated throughout. There is a very close link between farmers and machinery manufacturers which enables modifications and improvements of existing machines to be quickly incorporated into new models, while the advisory services are extremely practical and effective.

It would appear that while yields per acre are on the whole higher in the U.K. than in the U.S.A., the output per farm worker is much higher in the U.S.A.

An essential difference seems to be that while the American farmer tends to think more in terms of net return on outlay, the British farmer thinks of good husbandry, good ploughing, good tilth and a good seed bed, and is much more influenced by traditions and custom.

In the discussion more than one speaker expressed the view that one of the essential differences between American and British farming is that in the U.S.A. they cut out the frills, because of the shortage and dearness of agricultural labour. In the U.K. the

need is for more frill cutting and a more realistic approach to the problems; above all there is need for more intensive use of manpower. As one speaker put it, the difference seems to be that the American farmer takes his coat off and really gets down to the job.

Be this as it may, there can be no real doubt that the action taken by the Anglo-American Productivity Council in organising visits of this character is all to the good.

Phosphates and groundnuts

THE possibility of greatly increasing yields from peasant cultivation in tropical countries by the use of artificial fertilisers has been widely canvassed of recent years, and here the results of some recent experiments in Nigeria on the application of phosphatic fertilisers to groundnuts are of interest. They are contained in a paper by M. Greenwood, recently published in the *Empire Journal of Experimental Agriculture*.

Early work before the war had shown that on the phosphate deficient soils of Northern Nigeria increases of yield of the order of 200 lb. of groundnut kernels per acre could be obtained by the application of 50 lb. dressings of superphosphate. When the Groundnut Mission visited Nigeria in 1947 they recommended the issue of phosphatic fertilisers to peasants as one of the surest ways of increasing groundnut production without jeopardising food production. They also suggested experiments to ascertain safe and simple methods of application.

Earlier work had also shown that placement of phosphatic manures was likely to give good results, and the Mission suggested the use of pelletted fertilisers as a simple and convenient method of application. In 1947 and subsequent years, experiments were carried out with various types of phosphatic fertilisers in the form of stamped pellets and it was found that provided the pellets were separated from the seed by an interval of half an inch entirely satisfactory results followed.

It was also found, however, that the cost of pelleting made the method uneconomic, and attention was turned to the possibility of using granulated materials instead. Eventually it was found possible to produce oversize granules about one-third the size of the pellets at a reasonable cost and this was found to give results comparable with those obtained with pellets. Another result from the experiments was to show that single superphosphate was more efficient than other forms, and that this was due to the gypsum which it contained. The possibility of the effect being due to sulphur deficiency is being investigated.

The Nigerian North Regional Development Board have embarked upon a fertiliser distribution scheme whereby groups of farmers up to a total of 40,000 per annum each receive free a 56-lb. bag of specially prepared superphosphate for trial. In the year following free distribution fertilisers will be made available, to those who have found its use attractive, against payment.

The total exports of groundnuts from Nigeria is on the average 300,000 tons per year, and this involves the export of 3,000 tons of phosphoric anhydride, equivalent to 17,000 tons of single superphosphate. The efforts now being made are therefore highly important, since they represent, so far as we are aware, the first large-scale concerted attempt to redress the large annual loss of fertility which takes place through the export from native African territories of produce uncompensated by manurial dressings, while at the same time it should lead to an appreciable gain in production.

Magnesium for crops

THE position of magnesium as an essential plant nutrient has long been accepted. It is certainly not a trace or micro-nutrient for, like calcium, it has highly important structural duties in plant chemistry. Every molecule of chlorophyll, the green pigment of plants and the irreplaceable ' middleman ' of photo-synthesis, contains magnesium. Nevertheless, the supply of magnesium for crops has largely been left to chance. Magnesium deficiencies, ever-increasingly recognised in the past 20 years, have been regarded as special troubles in crop production, disorders to be cured as and when they occur. The case for including magnesium in fertilisers has not generally been accepted—some twelve months ago in London the discussion that followed Mr. Trefor Jones's paper on ' Magnesium as a Plant Nutrient ' gave little support for the opinion that compound fertilisers should include this element.

Agricultural chemists in eastern Germany have expressed more positive views during 1951. They contend, not illogically, that many chlorotic troubles of crops hitherto ascribed to soil acidity are in fact caused by magnesium deficiency. Precept seems to have been swiftly followed by practice and the potash industry in Germany is now producing magnesium-containing fertilisers, *e.g.* EMGE potash with 33 to 37% K_2O and 15% magnesium sulphate, REFORM potash with 26% each of K_2O and magnesium sulphate. This is a development that will be closely watched by the industries in all other countries where fertiliser use is well established. The convention of calling a nitrogen-phosphate-potash (NPK) mixture a ' complete fertiliser ' has always been verbally misleading, but in practice calcium (from the superphosphate used) and sulphur (from sulphate of ammonia and superphosphate) have also been supplied as undeclared constituents. Of the short list of essential and major plant nutrients, it has been magnesium that has been ignored. Nor was this wholly true

in the early days of the European industry, for the original Stassfurt kainit used to contain 27% of magnesium salts with its 20 to 21% of sulphate of potash ; processes of refinement developed early in this century reduced the magnesium salts content to a matter of 3 or 4%. The steady advance of refinement has virtually removed magnesium as an accidental associate of potassium in modern potassic fertilisers. The new German development is in fact a reversal of history. Magnesium salts, once looked upon as an impurity to be removed, are being deliberately added to potash in controlled and stated quantities !

It remains to be seen whether the new German fertilisers will provide significant crop responses. Even if this is demonstrated on a large scale, it will have to be remembered that German farming soils are mainly light soils and magnesium shortages are more likely to occur under those conditions. Nevertheless, crops remove large quantities of magnesium from soils whether they are light or heavy—a ton of oat grain contains nearly 5 lb. of magnesium ; cropping rotations may remove as much as 60 to 90 lb. of magnesium sulphate (equivalent) per year. The German venture is an experiment in what might be called *positive crop health*, supplying a requirement in diet regularly instead of waiting for shortage to be demonstrated and then applying emergency or *disease treatment* methods.

Training planners

WITH the spate of new development projects designed to improve agricultural production, the need is becoming increasingly apparent for personnel who have received special training in the assessment of such projects, the effects they can have on the economy of a region as a whole and the ancillary developments which can arise therefrom in the future.

To meet this need it is interesting to note a project recently launched under the joint sponsorship of FAO, the International Bank and the Turkish Government to set up in Turkey a training centre for improving the ability of selected officials and others to formulate and appraise agricultural projects in the Mediterranean region. The training is to include methods of appraising and estimating the costs, benefits and financial feasibility of such projects; also methods of summarising and presenting them to appropriate national and international authorities and financing institutions.

The lead thus given seems to meet a definite want. Recent history does not lack instances where large schemes of development have been launched without due and competent examination of all the implications. The example of this experiment in the Mediterranean region could well be followed in some other countries.

Agricultural development in West Africa

THE improvement of peasant agriculture is one of the major agricultural problems today. It is world-wide in its incidence and the pivotal need is to raise the output per individual worker and per unit of area cultivated, which are normally very low. This can only be done if resources and knowledge at the disposition of the small peasant cultivator can be increased so as to enable him to take advantage of the advances in agricultural technique which science makes available.

The approaches to the solution of the problem have been many and varied and one which is attracting increasing attention is that which has been evolved in the British Dependencies in West Africa through the inauguration of produce marketing boards.

Like many another project the origin of these was to an extent fortuitous and opportunist, since they took their rise from the exigencies of war; West Africa is *par excellence* a country of smallholders and there are, with a few exceptions, no large estates, which can serve as focuses from which improvements can radiate. Before the war the produce of peasant agriculture was purchased by a number of commercial firms which combined the purchase, bulking and export of native produce with the importation of trade goods for sale to cultivators and the community at large.

The advent of war, with the inevitable restrictions on shipping and dislocation of trade and prices, compelled the Government to establish a number of marketing schemes for West African produce, based on the one hand on ensuring that growers were able to continue to dispose of their produce at prices which would enable them to live, irrespective of whether it could be immediately exported or not, and on the other that prices were kept at a level which did not outstrip the limited supplies of imported consumer goods leading to runaway inflation.

Taken as a whole these schemes worked well and despite considerable criticism from some quarters, it was obvious that by and large this method of produce disposal represented a considerable advance on previous conditions. One of the main advantages was that they largely eliminated the violent price fluctuations which in the past had proved so great a source of difficulty.

Another was that, as a result of these activities, for the first time accumulated balances became available which could be used for the benefit of the various industries and of the community as a whole. One of the early results was the setting up in 1944 of the West African Cocoa Research Institute and the initiation of the campaign for the control of swollen shoot disease in the Gold Coast and Nigeria.

The post-war sequel

IT is not altogether surprising, therefore, that the success of these admittedly *ad hoc* efforts born of the exigencies of wartime conditions should have been translated into more permanent organisations after the restoration of peace. In the Gold Coast a Cocoa Marketing Board has been set up as a permanent body, while in Nigeria similar Boards have been established to handle cocoa, oil palm products, groundnuts and cotton. These Boards have a dual function, *viz.*: (*a*) to stabilise prices and (*b*) to foster and encourage developments, including research, which will benefit the primary producer.

In Nigeria it was soon realised that organisations primarily devoted to the marketing of produce were not *per se* the most suitable agencies for initiating and carrying into effect development projects. Consequently the next step was to set up development boards for the three main administrative regions. These are autonomous bodies financed entirely by the marketing boards, the membership of which is predominantly African and includes men who are in close touch with the needs of the primary producers. The scope of the measures which they undertake cover (*a*) the improvement of production, including cultivation, manuring, disease control, introduction of improved planting material, the improvement of processing, as well as the extension of research and investigation, (*b*) the improvement of marketing, including better communications for the evacuation of produce and the extension of co-operative financing of growers and (*c*) the initiation of measures for the general betterment of the farming community.

In the four years which have elapsed since the initiation of the first of these Boards a large number of schemes have been launched, including projects for the large-scale distribution of fertilisers, the erection of mills for the extraction of palm oil, the extension of rice cultivation and many others.

Another direction in which the marketing boards have accepted responsibility is the financing of the Oil Palm Research Station at Benin, originally founded in 1937 as a purely Nigerian project, and which it is now contemplated to establish as an autonomous research institution to serve the four West African dependencies on similar lines to the Cocoa Research Institute at Tafo.

It is still early to say definitely that this approach is a fully proved success, but there is no doubt that it possesses many promising features.

It has always been our view that the improvement of peasant agriculture must involve a measure of overall control of operations to enable smallholdings to be grouped and worked collectively, thereby achieving some of the efficiency of the large estate. By attacking the problem from the marketing side there does seem at least to be some prospect of achieving this end by processes which avoid in large measure the hardships and dissatisfaction inseparable from compulsory collectivisation.

Krilium

THE announcement at a recent meeting of the American Association for the Advancement of Science in Philadelphia of the discovery by Monsanto Chemicals of certain organic polymers which have remarkable properties in improving soil structure has created considerable interest. Their nature is not as yet completely disclosed and at present they are termed by the makers, Krilium. It is claimed that the application of relatively small quantities of the order of 1 lb. have an effect on the formation of soil aggregates corresponding to that obtained from 200 lb. of peat moss or 500 lb. of ordinary commercial compost.

The importance of structure in soils is discussed in a paper by Dr. Walter Russell, which appeared in the February 1951 issue of WORLD CROPS. As there pointed out, all methods of intensive land use tend to deteriorate soil structure, the most critical place being the surface layer and the principal causes being the shattering action of large fast falling rain drops and the effects of trampling when the soil is wet. Moreover, the maintenance of structure is all-important in controlling erosion.

If, therefore, compounds have been isolated which lead to the formation of soil aggregates of greater stability than normal, and have no other undesirable effects, *e.g.*, on soil biological relationships, it may well constitute an important step forward, provided the material can be supplied at an economic price. The present prospect seems to be that Krilium will sell at somewhat below $2 per lb.

It is stated that the great promise of the materials has been proved by numerous experiments in the U.S.A. No details are yet available, but early publication is forecast. The material has not so far appeared in England, although no doubt trials with it will be made in due course. It is expected that Krilium will find its chief application in market gardens and greenhouses while it may also be useful in general agriculture. Judgment must be suspended pending further trials, but developments will be watched with interest.

THIS MONTH'S COVER

This beautiful study shows a typical Malay 'Kampong' scene in Sumatra. In the foreground the rice sawahs have recently been planted out. The higher Kampong land in the background shows the characteristic mixture of coconuts, sugar palms, areca palms and other fruit trees planted around the closely spaced dwellings. Note the high, curved traditional 'Menangkabau' roofs of the latter.

(Photo: Indonesian Embassy)

Rainfall, Watershed and Stream Flow

With Illustrative Data from the Tennessee River Basin, U.S.A.

HARRY A. CURTIS

A director of the Tennessee Valley Authority

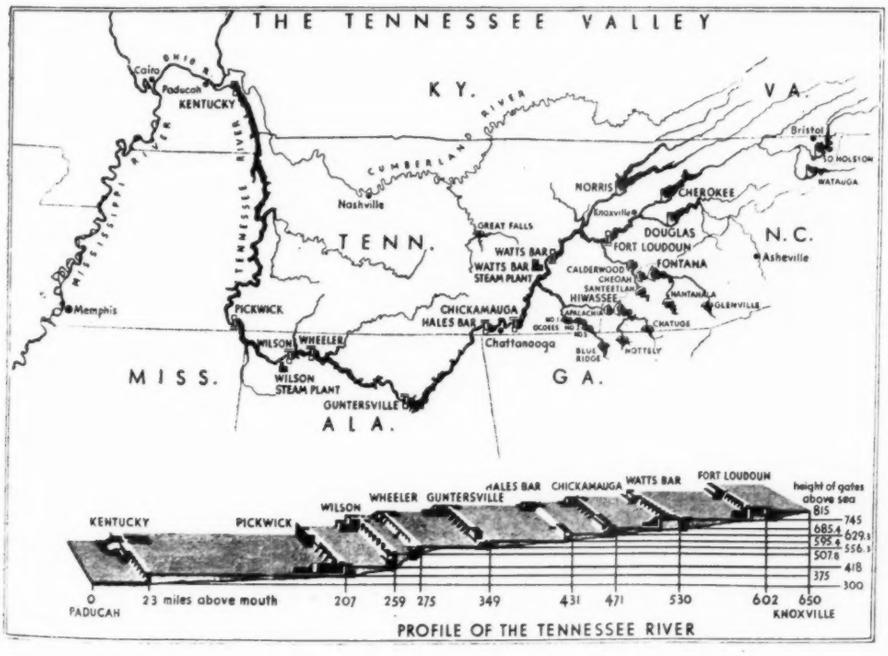
Of the rain which falls on a watershed only a part emerges as stream flow. The size of this is important, especially when questions of utilising it for the production of power, irrigation, and in other ways are at issue. In the article, the first part of which appears below, the author discusses the various ways in which rainfall is disposed of under natural conditions and the factors concerned, basing himself on data obtained from the Tennessee Valley undertaking in the U.S.A.; Mr. Curtis is a director of that great project and a previous article by him appeared in WORLD CROPS *for February 1950, outlining the main features of it.*

THE term 'watershed' may suggest that rain falling on such an area is shed to the streams as rain is shed from a house roof. This simple concept is commonly modified by the knowledge that some of the rain water soaks into the ground and later reappears in springs. Actually, the relationship of a watershed to the streams that drain it is complex and highly dynamic. It may come as a surprise to many people to learn that usually less than half the water that falls annually on a watershed leaves the area by way of the streams. The present article will discuss briefly some of the basic factors in the relationship of rainfall, watershed and stream flow.

The natural reservoirs of a watershed

The artificial reservoirs which may be created by dams in a system are supplemental to the natural reservoirs in its watershed. Each natural reservoir functions more or less as an artificial reservoir does, *i.e.* it receives water directly or indirectly from rain, retains it for a period of time and then loses it by discharge or by evaporation. Even the surface run-off water is, for a short time, in storage on the land; therefore it may be said that all the rain water reaching the streams and artificial reservoirs, except the very small portion falling directly thereinto, must first pass through one or more of the natural reservoirs.

Not all of the natural reservoirs discharge ultimately into the streams and artificial reservoirs; some return their stored water directly to the air, some supply water to growing plants which in turn deliver water to the air by transpiration. Most watersheds deliver, on the average, less than half of the rainfall to the streams, and in the Tennessee River Basin only about 42% of the rainfall leaves by way of the streams.



Vegetational reservoir

The first natural reservoir that rainwater fills is the surface of the vegetation that is wet by the rain. At first thought, it may seem that the storage volume of this is negligibly small; it is, to be sure, very shallow, but its area where there is a vigorous growth of forests, pastures and crops is very large, several times the area of the land itself. Nearly every rain fills the 'vegetation-surface reservoir'; in the Tennessee Valley, with an average rainfall of 51 in., there may be a hundred or more rains during a year at a given location, and the proportion of the total rainfall passing into and out of this reservoir annually is by no means negligibly small. Obviously the proportion of a rain intercepted depends upon many factors, the dominant ones being the surface area of the vegetation and the characteristics of the rainstorm.

One may arrive at estimates of the water storage volume of the vegetation reservoir in the Tennessee Valley using field data that give some idea of the quantity of water involved. Thus, assuming that the vegetation surface area is eight times as large as the area of the watershed and the depth of the water film on the wetter vegetation surface is 0.01 in., the reservoir capacity is the equivalent of 0.08 watershed in. of rain. Or, again, assume, as suggested by field measurements, that the interception is about 7.5 in. in a year of normal rainfall. If there were a hundred storms a year, the reservoir volume would be 0.075 watershed in. Obviously the volume of this reservoir is small in terms of rainfall, although its annual through-put of water is considerable. Obviously, also, none of the water that remains in it for a short period reaches the streams. It is returned into the air by evaporation.

Internal storage by vegetation

Another natural reservoir is that afforded internally by the vegetation. Living plants

contain large proportions of water. An estimate of the weight of all the vegetation on a large, well-covered watershed indicates that a great deal of water is stored temporarily in it, but in terms of watershed inches of rainfall this natural reservoir is negligibly small.

One may calculate its value approximately in the Tennessee Valley where some 54% of the land is in forest and the stands of large trees are not thick; assume that the green wood per acre weighs 50 tons and the water content of the trees averages about 45%. This indicates a water storage volume equivalent to 0.2 in. of rain. This calculation is obviously crude but indicates that the internal storage of water in the vegetation is small in terms of rainfall. The annual throughput of water, aside from transpiration, is also very small in terms of watershed inches of rain.

The storage of water in the soil

The soil and unconsolidated rock mantle of the watershed also afford water storage. It is convenient to designate two natural reservoirs here, one provided by the soil down to the water table and the other in the soil and loose rock below. For present purposes the first-named will be called the ' soil reservoir ' and the other the ' sub-water table reservoir.'

(a) The soil reservoir. It is common knowledge that soil will soak up water. A small portion is held very firmly and can be removed only by heating the soil to a high temperature or by exposing it to a very dry atmosphere; this is usually called the ' hygroscopic water.' Another portion is held in the micropores of the soil and is usually called ' capillary water,' it will not percolate through the soil under the pull of gravity, but will evaporate from the surface of the soil and the roots of living plants can take up a part of it; it is obviously of paramount importance in agriculture.

The water in the macropores and open channels of the soil will move downward under the influence of gravity and is usually referred to as ' gravitational water,' but actually there is no line of demarcation between the three. The terms hygroscopic, capillary and gravitational water merely indicate that a very small but not specifically defined portion is held less firmly but with sufficient force to prevent percolation, and a third so loosely that it will move downward under the influence of gravity. The situation can be defined more accurately by a numerical scale related to the magnitude of the force involved. One such is known as the pF scale and is defined as the logarithm of the height in centimeters of a column of water whose weight force would equal that required to move an increment of water from the soil being tested. When the measured values of the pF for a given soil are plotted against the moisture content, a smooth curve is obtained on which points may be located arbitrarily to mark approximately the limits of pF corresponding to the rough classification of soil moisture as hygroscopic, capillary and gravitational.

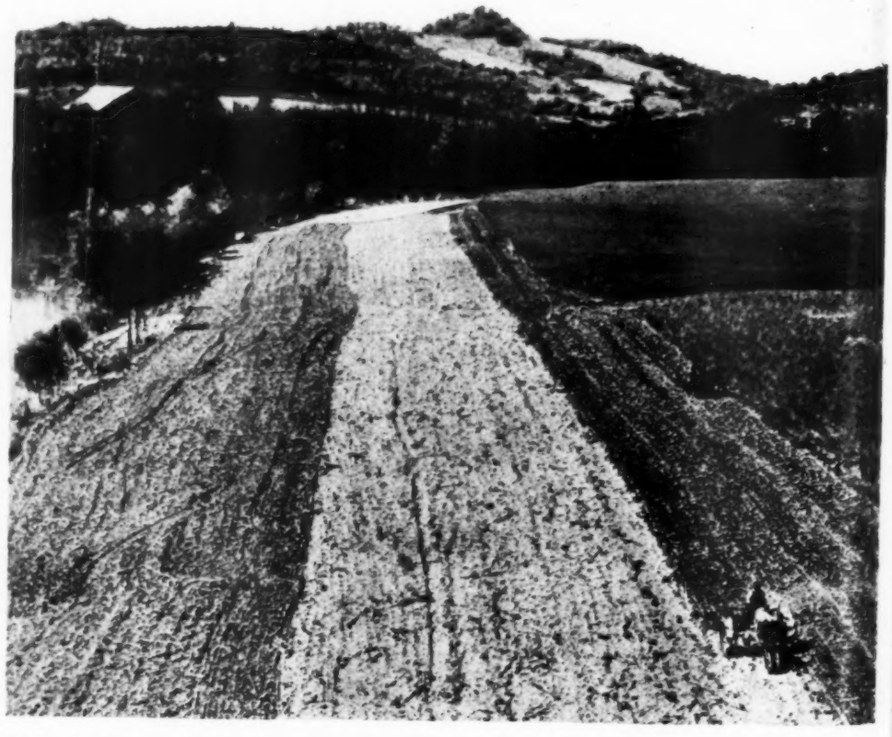
Each soil tested will result in a different curve when the pF is plotted against soil moisture content.

(b) The sub-water table reservoir. None of the water stored in soil, except the so-called gravitational water, ever reaches the streams. Some evaporates from the ground surface, but mainly the reservoir serves as a source of the water required by growing plants. However, it does not follow that the soil reservoir is unrelated to the streams that drain a watershed; for below the soil reservoir is another, designated the sub-water table reservoir. The upper limit of this is commonly called the water table, and the reservoir extends downward through the soil and unconsolidated rock as far as water penetrates. The sub-water table reservoir can be replenished only by water which percolates through the soil reservoir and so long as the last-named is not filled, *i.e.* so long as it can take up water and hold it against the downward pull of gravity, little or no water can percolate to the sub-water table reservoir. The latter table discharges water slowly to the streams, but since its water must pass first through the soil reservoir and then through the sub-water table reservoir, both reservoirs are involved in the matter of water yield to the field.

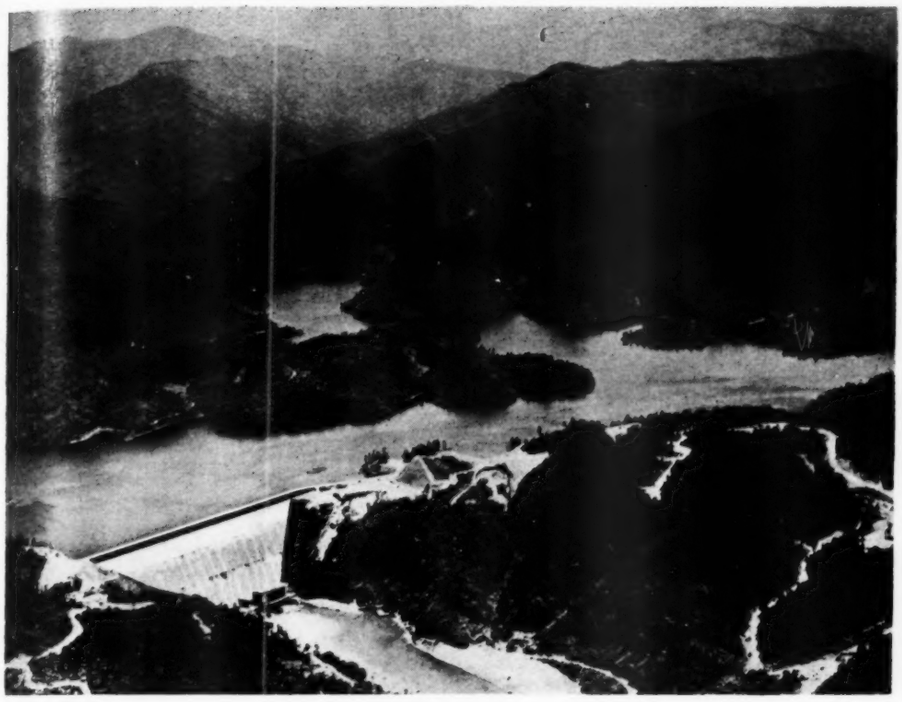
Amount of water stored in the soil

It is difficult to arrive at a good estimate of the volume of water stored in the soil reservoir of a large watershed. In small areas the water table level and the average soil moisture content may be determined readily at any given time, and the volume of water calculated. But the water table rises and falls from time to time, changing the volume of the soil reservoir while the moisture content of the upper few feet of soil fluctuates as water is evaporated at the surface or withdrawn by the roots of plants. The maximum amount of capillary water that can be retained, *i.e.* ' the field capacity,' varies widely for different soils and for the same soil in different physical conditions; thus the maximum soil moisture at nine stations in the Tennessee Valley varied from the equivalent of 19.6 to 40.6 in. of rain water.

The soil reservoir is never completely emptied. Plants cease growing and eventually wilt, long before all the capillary water has been removed. In the Tennessee Valley it is estimated that the average



This land was subject to drought and flooding before TVA enterprise made it tillable



Fontana Dam, U.S.A., is the world's fourth largest with over 1,000,000 acre-feet of storage capacity. Note the vast natural water reservoir afforded by the vegetation

variation in soil moisture is the equivalent of about 6 in. of rain. This is not the total water storage volume but represents the active storage range, corresponding to the active storage range in an artificial reservoir. In any given year the available range may not be utilised and, obviously, the active storage volume does not define the annual water throughput.

Capillary storage

The average annual quantity of water stored as capillary moisture in the Tennessee Valley and subsequently removed by evaporation from the ground surface and by transpiration through growing vegetation may be estimated on the basis of certain measurements and some reasonable assumptions. Thus, the average rainfall in the Valley is about 51 in. as already indicated. Probably the vegetation intercepts and returns to the atmosphere annually some 7.5 in., leaving 43.5 in. to reach the ground. The average flow of the Tennessee River at its mouth accounts for about 21.4 watershed in. This comes from two sources, the surface run-off and the underground flow; measurements indicate that a little less comes by the first-named route than by the last-named. Assuming, therefore, that the surface run-off is 10 in. and the under-ground flow is 11.4 in., and deducting the 21.4 in. from the 43.5 in. that reach the ground, it follows that 22.1 in. of water must have been stored in the soil reservoir and subsequently lost by evapotranspiration processes.

Sub-water table storage

The total water storage volume of the sub-water table reservoir is even more difficult to estimate. In both the micropores and the macropores are filled; the upper level, *i.e.* the water table, fluctuates, while the lower limit varies widely. It is, in fact, almost impossible to locate the floor of the reservoir. The volume of active storage of a small watershed may, however, be determined approximately by observations of the water table levels and the water yield during a long dry period that has followed a long rainy period. Ordinarily about half the water in the active storage volume will reach the stream in the first month of the period, and about a quarter in the second month, *i.e.* if the water yield be plotted against time, the resultant recession curve is essentially logarithmic, the yield becoming very small after a few months. Measurements at a number of places in the Tennessee Valley show an active sub-water table storage varying from about 2.5 to 8 in.

The annual flow of water through this natural reservoir is larger than its active volume storage and, as indicated, amounts to about 11.4 in. on the average in the Tennessee Valley.

The foregoing rough estimates may be summarised as follows:—

Natural Reservoir	Estimate of Water Storage Volume	Estimate of Annual Throughput of Water
Vegetation surface	Of the order of 0.1 in.	7.5 in.
In vegetation	Of the order 0.1 to 0.2 in.	Very small
Soil	Active storage in first 6 ft. about 6 in.	22.1 in. plus 11.4 in.
Surface run-off	No estimate	10 in.
Sub-water table	2.5 in. to 8 in.	11.4 in.
Streams	No estimate	21.4 in.

In the above estimates only the major partition of rainfall into stream flow (21.4 in.) and evapotranspiration (29.6 in.) is well established. The other estimated quantities are derived from scanty measurements and some reasonable assumptions.

For a watershed other than that of the Tennessee River, the distribution would be different, but it is known that in several other large watersheds less than half the average annual rainfall leaves the watersheds by drainage.

(*Part II will appear in our March issue.*)

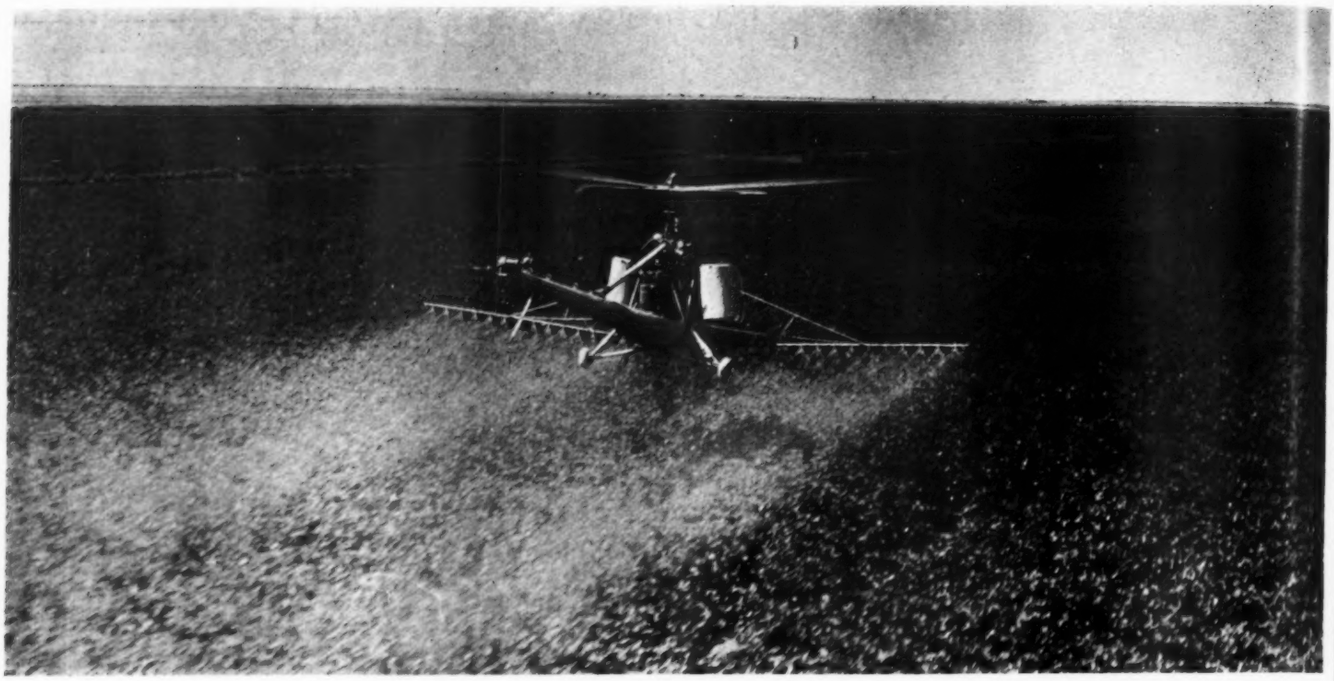
Photos: U.S.I.S.

U.S. Fertiliser Supply Prospects

The head of the U.S. Department of Agriculture, Mr. Brannan, has stated that fertiliser supplies for the 1952 crop will not be large enough to meet anticipated demand, even though the total tonnage of commercial plant nutrients will probably exceed the record supplies for the year ending June 30, 1951.

He said the total supply of nitrogen available for fertiliser purposes in 1952 was expected to exceed the 1951 supply by a small amount, but would not be sufficient to meet estimated requirements. Potash supply was expected to be at least 10% greater than in 1951, although it was not likely to meet all demands. Phosphate supplies would be reduced because of the tight sulphur and sulphuric acid supply situation.

Mr. Brannan said the Department of Agriculture was attacking the shortage on two fronts. First, it was promoting industrial development needed to increase production of fertiliser materials and, second, it was promoting the more efficient use of fertiliser materials. Recommendations for nitrogen plant expansion were designed to balance supply with demand within the next 18 to 24 months. As for phosphate, Department efforts were directed towards encouraging the development of new sources of sulphur and sponsoring installation of processes to treat phosphate rock with nitric acid. Such installations, however, were not expected to figure in the overall supply of available phosphates in the immediate future.



Spraying Gezira cotton against jassids by helicopter

The Gezira Scheme in the Anglo-Egyptian Sudan

PART II

H. FERGUSON, B.Sc., N.D.A., N.D.D.

Chief Agronomist, Research Service, Sudan Ministry of Agriculture

THE Gezira lies within that part of tropical Africa subject to a continental climate and characterised by very hot summers and cool dry winters. It is just within the summer rainfall zone. The mean annual rainfall at the Gezira Research Farm in the central Gezira is 16 in., falling mainly during July and August. This is liable to considerable variation, and though of little consequence as a source of water for irrigated crops, its influence on them is considerable.

The Gezira environment

Though the soil type is characteristic of this climatic zone, Gezira soils have certain unique features, being alkaline cracking clay of great depth and superficially very uniform. The clay fraction varies around 60% and, as there is a high sodium content, the soil is very impermeable. Soil cracks are considered to be of great importance in maintaining structure and allowing free movement of water and air. Organic matter content is very low, and of no importance in maintaining structure.

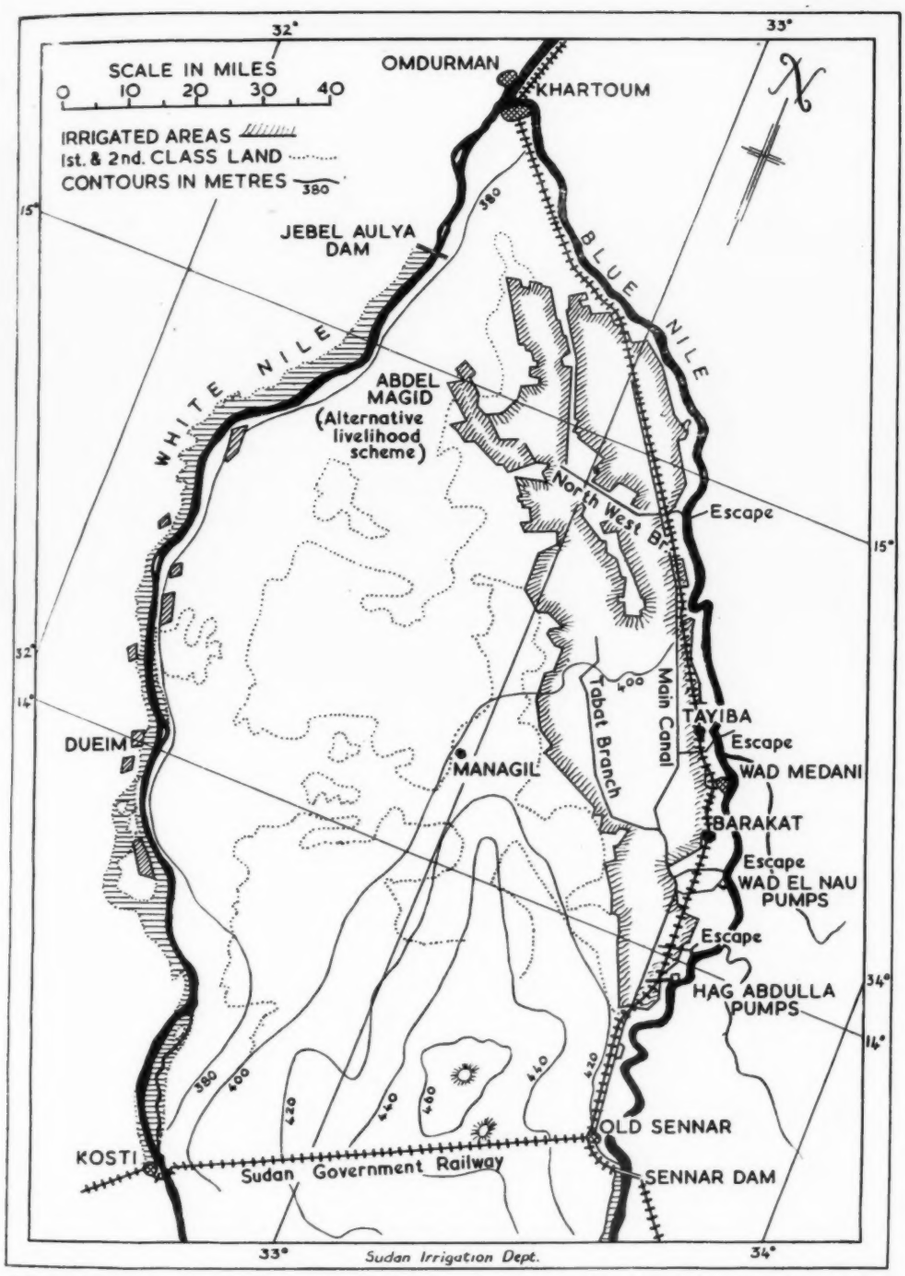
This, the second part of the series of three articles on agriculture in the Anglo - Egyptian Sudan, describes natural conditions in the Gezira and the form of agriculture practised. The third and concluding article, dealing with the research carried out there, will appear in our issue for March.

The 'salt'* content varies from under .25% to over .5% in the top four feet, tending to be higher in the areas of lower rainfall to the north and west of the scheme. It is high enough to affect the growth and yield of crops, though it causes much less damage than it would in lighter soils. Salt content was found to be a reliable measure of soil productivity and a salt survey of the whole Gezira area has been the basis for choice of areas for irrigation extension. The 'sodium value' which measures soluble plus exchangeable sodium has proved to be an even better measure and is now being used extensively in soil surveys. Gezira soils contain adequate amounts of all plant food except nitrogen. Soil nitrates vary throughout the season, but are always very low, and applications of nitrogenous fertilisers always give significant increases in yield.

The climax vegetation of the Gezira would be classed as 'Acacia short grass scrub'. Before development there were considerable areas of closed acacia bush which had to be cleared by hand, though elsewhere grazing and cultivation had resulted in large areas of open grassland. This produces an ephemeral vegetation of herbs and grasses after the rains, which is grazed off as the season advances. Irrigation has brought changes in the natural vegetation and there is now a well established weed flora within the scheme.

The inhabitants of the Gezira are of

* Used for all soluble salts.



Map of Gezira illustrating irrigated areas and areas in which level and quality of soil are satisfactory for irrigation

Arab and Negro extraction. Before the scheme started they were semi-nomadic, settling down on the Gezira plain to grow a sorghum crop during the rains, but allowing their flocks and herds free range, and if necessary migrating with them in the dry season to other regions in search of grazing. Irrigation and cotton growing meant a great change in their way of life, and, though they have become expert cotton growers, they are still far from being real peasant farmers.

Irrigation considerations

The use of the Nile waters is controlled by agreement with Egypt. The Blue Nile flood starts in July and from then till the end of December provides enough water for the requirements of Egypt and the Sudan. From January till April only a fixed amount of ' stored ' water is available for the Gezira and thereafter the remainder of the stored water goes to Egypt. The Sennar dam thus functions partly as a barrage and partly as a storage reservoir. It is equipped with sluices in the river channel which remain partly open till the main flood is past, thus preventing silting within the dam. By the end of October, when the water is much less silty, sluices are closed, and by the beginning of December the dam has been filled to full storage capacity. The total capacity of the dam is 781 million cubic metres, of which 448 million can be discharged into the main Gezira canal at its full working level. Heightening of the dam, at present in progress, will increase the storage capacity.

During the period from April till July, ' domestic ' water supplies are pumped direct from the river into part of the canal system, but these are not available for irrigation. Thus perennial crops are not possible in the Gezira and the cropping system has to be planned in accordance with the availability of water.

The water from the dam enters the main canal by gravity flow and is distributed by gravity throughout the scheme, by a system of canals over 3,000 miles in length. The flatness of the Gezira plain facilitated the laying out of the scheme, but it is so flat that the fullest use had to be made of small differences in level to maintain a flow throughout the scheme. A ' night storage ' system of watering is practised. The minor canals between each regulator are designed to hold a head of water 9 to 18 in. higher than that actually required to maintain a flow on to the land. Watering takes place during the hours of daylight and by the time the field outlet pipes are closed in the evening the minor canals are empty. The flow in the main and major canals is continuous day and night, and by shutting the regulators along the minor canals each section of the latter is filled to full storage level during the night. The advantages of the night storage system are obvious, but it has the great disadvantage that it allows silt to settle in the minor canals. This not only necessitates more canal cleaning, but encourages canal weeds, which in turn slow down the flow of water.

The extremely impermeable character of the Gezira soil has an important bearing on irrigation inasmuch as the irrigation canals do not need lining and there is virtually no seepage even from canals above ground level. The soil is so impermeable that there is no through drainage, and, the natural water table being about 50 ft. below the surface, there is no chance of the scheme being ruined by a rising water table, as has happened elsewhere. All losses of irrigation water are by transpiration and evaporation. This, of course, introduces the danger of salt accumulation. Fortunately the Blue Nile waters have a relatively low salt content, and this problem is not considered to be of immediate importance. Surface waterlogging occurs after irrigation and cannot be avoided as heavy watering is required to ensure penetration and availability to the plant, both of which are reduced by the clay and salt content of the soil.

Crop husbandry

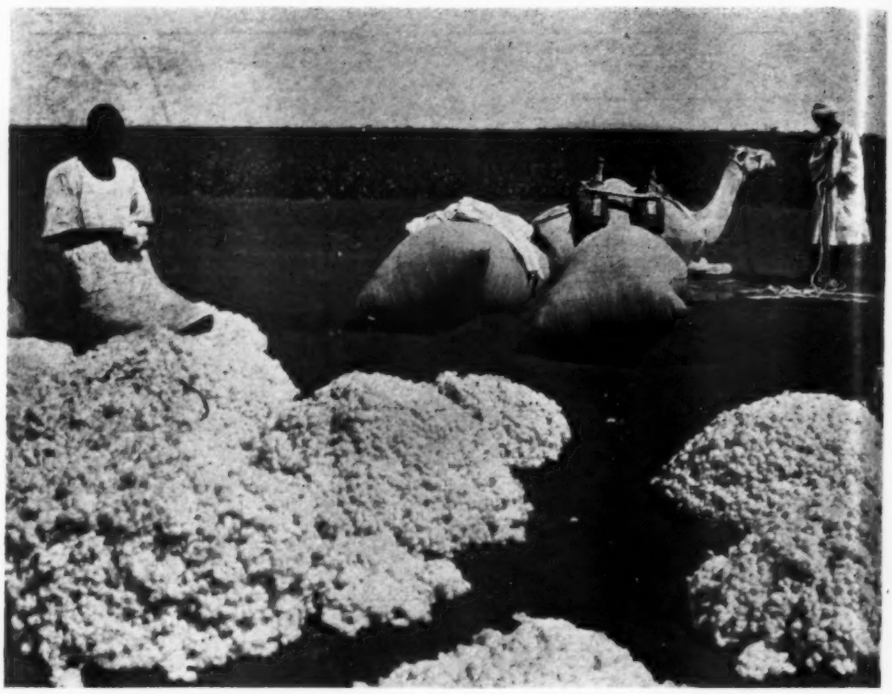
Inevitably cotton is given first consideration and the farming system and methods are geared to the production of this crop. Thus all water available during the rationed period is utilised for cotton, dates of operations for other crops are arranged not to clash with the best dates for cotton, and if labour, water or equipment is at any time scarce, cotton is given priority.

Each 40-feddan tenancy is divided into 10 feddan units. A series (usually nine) of these form a rotational unit or ' number ' which is watered from one main field channel. Each tenant has 10 feddans of cotton, five of dura and about two and a half of lubia, the last two being grown in alternate years on the neighbouring tenancy in order not to split the 10 feddan unit, and to facilitate crop rotation. The rotation at present practised throughout almost the entire scheme is an eight-course one, covering two tenancies : Fallow-Fallow-Cotton - Fallow - Dura - Lubia - Fallow - Cotton. Generally only about half the lubia area is taken up so that in practice the second part of the rotation is (Lubia or Fallow)-Fallow-Cotton. This rotation was introduced in the 1933/34 season and has proved to be very satisfactory. Before that time a six-course rotation Dura-Fallow - Cotton - Lubia - Fallow - Cotton was used. The area of the tenancies at that time was 30 feddans including 10 of cotton, and this rotation was fitted into one tenancy by accommodating both lubia and dura in one 10-feddan unit. This rotation was retained in very small areas of the Gezira for comparison and is still practised in some nearby ' alternative livelihood ' schemes where there is slightly greater emphasis on grain and fodder. Though fertility is probably not maintained at quite as high a level in the six-course rotation it is quite satisfactory, specially if cotton and/or dura are manured. It was abandoned at a time when drastic action was called for.

Fallow periods

Between 1929 and 1934 some extremely low yields of cotton were obtained. These were mainly due to blackarm and leaf curl, and the wider rotation was introduced primarily to help in the control of these diseases. It will be noted that there is a fallow before and after each cotton crop. The fallow after cotton was introduced in 1934 in order to make the clean up of cotton debris more thorough, and to allow of the complete destruction of cotton seedlings and ratoons. The former were the main foci of blackarm infection, and the latter of leaf curl, and if an irrigated crop followed cotton they were not only encouraged, but were hidden by it. The fallow before cotton is a practical necessity, as preparation for the cotton crop has to be started in some parts of the scheme eight or nine months before the crop is sown. Also experiments have confirmed that a fallow immediately before cotton generally results in a higher yield than does even a legume crop.

When considering these rotations it must be remembered that in the Gezira, water and not land is the factor limiting agriculture. The critical criterion of productivity is the yield per unit of water and not per gross unit of land, and in the eight-course rotation it is not a waste of productive land to have 50% of the tenancy fallow. Considerable nitrogen fixation by *Azotobacter* and nitrification of crop debris takes place in fallows, and in practice fallows and leguminous crops are considered to be of equal rotational value. It is undesirable to have two non-legumes in succession—for example, the yield of dura in the cotton-dura-fallow series is about half that in the cotton-fallow-dura series. Thus the inclusion of a sufficient number of fallows is a cheap and easy way to maintain fertility, and is satisfactory while water and not land is limited. In a closer rotation fertility could be maintained by manuring with nitrogenous fertilisers, but it has been found that the response of a *good* crop to a reasonable application of manure is, if anything, greater than the response of a *bad* crop, and it is thus more economical to apply fertilisers in a wide rotation.



A tenant preparing his seed cotton for dispatch to the collecting station

The fallows of the present eight-course rotation could be utilised by growing crops which require only free period watering. Possible crops include certain cash and fodder crops. The former are mainly non-legumes and it is doubtful if any of them would stand the cost of manuring on top of their other production costs. Leguminous fodder crops could be grown without any call on soil fertility, and, were the control of blackarm and leaf curl insured, they would fit in after cotton in the eight-course rotation. The fallow before cotton will continue to be desirable for preparatory cultivations and to allow crop debris to rot. Increased fodder crops would only be profitable if there were a change in the tenant's attitude to his livestock. Until this change is achieved, or until some ' free period ' cash crop is considered sufficiently profitable, the present wide eight-course rotation is entirely satisfactory from the agricultural point of view. As mentioned later the above possibilities are under consideration at the present time.

Watering intervals

Except at the time of establishment or during rainy weather water is applied to cotton at approximately fortnightly intervals. At each watering approximately 450 cubic metres of water per feddan is applied. This is equivalent to about four in. of rainfall. Cotton receives up to 15 such waterings, dura three or four at slightly longer intervals, and lubia four to eight.

After cotton has been watered and picked

Harvesting the sorghum crop

for the last time there follows the annual dry period (April till July). This is of special importance in controlling pests and diseases, and during it a 'scorched earth' policy is imposed by government order. All cotton debris and alternate host plants are destroyed within and around the scheme. This dry period with its attendant clean up has undoubtedly been a major factor in the success of the scheme, and disaster might well result from lowering the efficiency of the clean up.

Cultivation

The main cultivations in the rotation cycle are carried out before the cotton crop. Normally the soil is ploughed and ridged in one operation. Extra operations to improve tilth or control weeds are carried out at the discretion of the block inspector. Most ploughing is done by machinery, but some is done by bulls, one pair being used to pull single furrow ploughs or ridgers. Bulls are of especial value for putting up the tie ridges and channels which are laid across the crop ridges to control irrigation. For many years cable tackle was used for ploughing and ridging, and because of the regularity of the layout and flatness of the land this was eminently successful. It is now being replaced by wheeled and track tractors as these can be used for a wider variety of work especially in the slack period.

Manuring

Large areas of cotton are manured with nitrogenous fertilisers. Nitrate of ammonia is being used at present, but sulphate of ammonia and nitrate of lime have both been satisfactorily used in the past. Because of its sodium content nitrate of soda has been considered unsuitable. In the dry climate of the Gezira there is no loss by leaching and little loss of gaseous ammonia, so that fertiliser can be applied several months before the crop is sown. Advantage is taken of this in practice, the fertiliser being distributed to tenants and applied by them during the slack season. About 25% increase in cotton yield is obtained from applications of 45 lb. of nitrogen per feddan.

Cultivation for other purposes

Little or no preparatory cultivation is done for dura or lubia. Dura is sown on flat land segmented by irrigation channels and ridges. Lack of pre-cultivation appears to have no detrimental effect except that the absence of ridges makes watering more difficult. Land for lubia is usually ridged by bull ploughs, lubia being much more susceptible to irregular watering than dura.

A certain amount of cultivation is carried out on fallows to control weeds. Annual weeds are destroyed by light surface cultivation. Perennial weeds, in particular nut grass (*Cyperus rotundus*), are controlled by deep ploughing, the object of which is to cut off the perrenating tuber or stolon from its roots. Much fallow weed control is carried out only on an experimental scale.

Even if the tenant with the help of his family felt like doing so, he could not cope with all the manual work of his own holding at all seasons, and there is a considerable labour force employed by the tenants. This reaches its peak at cotton picking time when entire families immigrate into the Gezira. There is another peak demand when cotton is being weeded. This labour comes partly from within the scheme and partly from the non-irrigated area to the south, east and west of the scheme where the inhabitants have little to do after they have attended to their crops of raingrown dura.

The cotton crop

All the cotton grown in the Gezira is of the Egyptian type (*Gossypium barbadense* L.), which, by virtue of its superior quality and higher yield, is much more profitable than American types. At present two main varieties are grown: Domains Sakel (Sakellarides) and X1730A. Sakel produces fine strong lint with an average staple of 1½ in. X1730A has a slightly coarser lint, but usually gives a somewhat higher yield. Sakel was originally introduced from Egypt and was grown until 1935. X1730A was bred by line selection from Sakel. In the early 1930's blackarm and leaf curl diseases threatened disaster, and A. R. Lambert, after carrying out observations on thousands of cotton plants selected the progenitor of X1730A which was fully resistant to leaf curl and more resistant to blackarm than was Sakel. X1730A is a more vigorous variety than Sakel tending to go on producing new leaves, sympodia and flower buds; its 'resistance' to blackarm is mainly due to its ability to recover from attack. X1730A is now grown in the southern half of the Gezira where blackarm tends to be more severe, and where its superiority in yield is more marked.

Cultural operations

Cultural operations are largely standardised throughout the scheme and are based not only on experience, but on exhaustive and reliable experimentation. Sowing is started on August 10 and is usually completed by the end of the month. Earlier sowing is possible but, by delaying till mid-August, the period of heaviest rain, which causes spread of blackarm, is avoided. Sowing is done by the traditional native sowing stick or 'seluka', and, though satisfactory results have been obtained by machinery, hand sowing is often possible when the soil is too wet for machines. The spacing used is 32 in. between ridges and 16 in. between holes. Plants are thinned to three per hole, and

after thinning and weeding are completed, the crop is reridged. Apart from watering and possibly light weeding no other operation is necessary till harvest time. Flowering starts in late October, bolls open by the end of December and picking usually starts in early January. Egyptian cottons flower and fruit over a longer period than American cottons, and picking is not completed till April. Picking is arranged to take place during the few days before each watering when the soil is dry, so that there are usually about six pickings. When picking is finally completed livestock are allowed to graze the cotton before the clean up, which is the last, and one of the most important operations.

Seed cotton is despatched under each tenant's own mark to the ginneries where expert graders classify it into six grades. The tenant is ultimately paid according to his yield and grade. Both yields and grades vary considerably between places and between seasons. The average yield is in the region of four kantars* per feddan, and the bulk of the crop falls in the middle grades.

Pests and diseases of cotton

Pests and diseases are amongst the most important factors affecting the cotton crop and their control has become an essential part of the standard routine of the scheme.

Blackarm

Blackarm is caused by a bacterium (*Xanthomonas malvacearum*) which infects the leaves and stems, forming dead blackened patches which cause defoliation and, if severe, death of the plant. This results in serious losses of yield. Blackarm was recorded on cotton plants by Massey in 1922 and was recognised as a danger right from the beginning. The infection reached a serious level in the early 1930's. Blackarm is seed borne (' primary ' infection) and is carried over and spread by wind-borne infected crop debris. Rain splash carries debris from the soil to the leaf, and moist conditions encourage the entry of the organisation into the leaf. The methods of control are based on all these considerations. Seed is obtained from a comparatively blackarm free region (the Gash) and is disinfected with mercurial dust. The pulling of cotton stalks, and clean up and burning of all cotton debris is very thoroughly carried out. Cotton crops are, if possible, not grown in adjacent ' numbers ' in successive years. Seedlings appearing on old cotton plots often suffer from primary infection and all volunteer seedlings are pulled out as soon as seen. Sowing is delayed till after the main rains are over so that, except in seasons of late rains, the crop misses the main infective period. The introduction of X1730A, mentioned above, also did much to control blackarm, and there are now available varieties which have true genetical resistance to the disease. The combined result of all these measures is that, though blackarm is still endemic, it no longer causes disastrous losses of crop.

Leaf curl

The symptoms of leaf curl disease were first noted by Lambert on a few plants, but by 1927-28 it had spread throughout the crop. Leaf curl was later shown to be due to a virus which was transmitted by cotton whitefly (*Bemisia gossypiperda*). It causes crinkling of the leaves and abnormal growth of new shoots. Flowering is suppressed, and this, together with the metabolic disturbance caused by the disease, results in loss of crop. If infection starts early in the season the loss may be considerable. As in the case of blackarm, leaf curl became epidemic in the early thirties. The main source of infection was found to be ratoon plants from the previous crop which had been infected in the previous season. Thus, pulling out instead of cutting cotton stalks was instituted, and any ratoons resulting from faulty pulling were destroyed as soon as seen. Pulling of cotton stalks is an immense task. They are too firmly rooted to pull by hand and a pincer and lever device has been invented to do it. Leaf curl also infects certain other malvaceous plants, and these are destroyed to control it and also pink bollworm. The introduction of X1730A was another important measure in the control of leaf curl. At the time when control measures for leaf curl and blackarm were being established, the rotations were widened to allow of the very thorough destruction of seedlings and ratoons. Like blackarm, leaf curl is now very effectively controlled, but, only as long as these control measures are strictly carried out is the cotton crop secure against its most serious threat.

Bollworms

The pink bollworm (*Platyedra gossypiella*), the Egyptian bollworm (*Earias insulana*) and the American bollworm (*Heliothis armigera*) all do damage to cotton in the Gezira, but the first is the most serious. All cause some loss of buds and bolls, but control measures have been effective in keeping infestation at a safe level. Pink bollworm is carried over from one season to the next by resting larvae in the cotton seed or on alternative host plants. The end of season clean up is an important control measure. In addition, no unginned cotton is allowed in houses or ginneries during the dead season. Seed for sowing is heated for a period of two hours to approximately 140° F., at which temperature bollworm larvae are killed but germination is not impaired. The growing of okra (*Hibiscus esculentus*) which is an alternate host is forbidden during the dead season.

Sowing cotton by 'seluka'; holes are made by the sowing stick and seed dropped in and covered by the women and children seen behind

* One kantar of seed cotton equals approximately 315 lb., producing approximately 100 lb. of lint.

Jassids

The most serious insect pest of cotton in the Gezira is the jassid (*Empoasca libyca*), which causes damage to leaves and considerable loss of yield. Jassids tend to be heavier in the north of the scheme where rainfall is lower, and in seasons of poor rains. When the effectiveness of DDT against them was established, contracts were made to spray a part of the crop. Spraying was found to be profitable and at the present time about three-quarters of the crop is sprayed. Generally most of the northern half of the scheme is done, but within the short period when spraying has to be carried out the machines can be switched to any part of the scheme. Spraying was originally done by tractor sprayer, but part is now done by aircraft. The latter has the advantage that the crop can be sprayed whether the soil is wet or dry.

Cotton picking

Other pests and diseases

In seasons of poor rainfall cotton seedlings are seriously damaged by flea beetles, there being no weed vegetation for them to feed on. They are checked by dusting with gammexane powder, applied by power blower from the windward edge of the plot, or from within the plot by hand blower or duster. Full-scale control would necessitate spraying or dusting all the infested crop, which is not practicable during the rainy weather when infestation takes place.

A number of less important pests affect the cotton crop some of them occasionally doing severe local damage. These include termites, thrips, aphids, whiteflies and locusts. A wilt ' disease ' sometimes causes loss of crop. The etiology of this disease has not been established, but it is thought to be caused by physiological disorders of the root.

Aerial view—part sorghum ' number ' in foreground, cotton ' number ' in middle

The dura and lubia crops are grown primarily to provide the tenant with food and fodder, though there is always a market for them. Dura grain is the staple cereal of the Gezira and its straw is one of the main sources of fodder. Lubia is grown mainly for fodder, but a crop of beans is harvested and used as a pulse.

Dura

The main variety of dura grown is Feterita. This is a white grained type popular in the Gezira. Other varieties grown on a much smaller scale are Wad Fahl, Gassabi, Hemeisi and Dwarf White Milo. The last was proved to be a better yielder than Feterita, but has not become popular.

Tie ridges and channels for irrigation are set up but no ploughing or ridging, except on very weedy land, is done for dura. The land is watered by the first irrigation water to arrive in July, or by rain, and seed is sown by ' seluka ' as the ground dries. Apart from weeding and watering, the crop gets no attention till it matures about three months after sowing. Harvesting is done by hand, the stalk being cut near the head. Later the straw is cut and stacked in the field for use as fodder. Average yields of 1,400 lb. of grain and 6,000 lb. of straw per feddan are obtained. Threshing is done by hand, though machines have been used successfully, and may soon be established on a co-operative basis. Grain is stored in circular pits sited where surface water will not collect. The pit is sealed off with soil and the grain having been put in bone dry, it remains in good condition for two or three years.

Pests and diseases

The parasitic plant *Striga hermonthica* (witchweed) attaches itself to dura roots, and misappropriates the host plants' nutrients. *Striga*, if severe, can reduce the yield to nothing, and though it is severe only in patches, is probably the worst enemy of the dura crop. Smut (*Sphacelotheca sorghi*) is potentially serious, but is effectively controlled by treating the seed with copper carbonate. Dura also suffers from some other pests which occasionally may be severe. These include birds and other predators, locusts, grasshoppers, aphids, stem borer (*Sesamia cretica*), andat bug (*Agonoscelis versicolor*), and midge (*Contarinia sorghicola*).

Lubia

The lubia crop is sown in much the same way as dura, most often on ridges. It can be sown either in July before cotton or in September after cotton has been established. July sown lubia suffers from a bacterial disease (*Xanthomonas phaseoli*) which produces symptoms very similar to those of blackarm, and is encouraged by wet weather. Thus most lubia is sown in September. Its foliage is cut once or twice or grazed for fodder, and before the final grazing-off a crop of beans is taken. The lubia crop is often used to attract cotton pickers to the scheme, being offered as grazing for their animals.

Other crops

No other crops are grown extensively on the scheme. Wheat is grown to some extent on fringe land outside the rotation in the north and west of the scheme. It is

sown as a winter crop as only the cool winter conditions suit it, and thus it makes demands on stored water. Vegetables and groundnuts are sometimes grown for home consumption or local sale in part of the lubia rotation. Tree crops cannot be grown because of lack of perennial irrigation, but some small plantations are maintained by using the domestic water supply. Consequently the Gezira is for the most part completely devoid of trees and there is an acute shortage of domestic fuel.

Livestock

There are large numbers of livestock in the Gezira, mainly goats, cattle and sheep. Apart from the few bulls used for ploughing the livestock have, however, no part in the scheme itself. They are still herded in large herds as they were before the scheme started, and range over fallows and canal banks. It is considered by many that the next major step in development should be the introduction of a form of mixed husbandry on an individual or co-operative basis. This could be achieved by controlling livestock, controlling and utilising fallows for fodder production, widening the range of cropping and extending the use of machinery. Mixed husbandry might not contribute much to building up fertility, but at least would maintain it, improve the quality of livestock and increase the tenant's economic and social security. The Gezira Board are carrying out an experiment on these lines in collaboration with a small group of tenancies.

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(The concluding part of this series will appear next month.)

Photos : Pp. 50, 53 and 55 (left), Public Relations Office, Khartoum; p. 54 Gezira Research Farm; p. 55 (top) Gezira Information Office.

New Secretary for East Malling

Mr. C. T. Royle, Secretary of East Malling Research Station, retired on December 31, 1951, after 18 years' service. Since he took up his post in 1933 the experimental farm has doubled in size and the research staff quadrupled.

He is succeeded by Mr. T. R. Littlehales who was his assistant for two years.

Agriculturalists Honoured

In the British New Year Honours List appear the names of the following for services connected with agriculture, to whom WORLD CROPS tenders its respectful felicitations:—

VISCOUNT

Robert Spear Hudson, C.H., M.P., Wartime Minister of Agriculture.

KNIGHT BACHELOR

Hans Eric Miller, Chairman, International Rubber Development Board.

C.B.

R. Herbert, Under-Secretary, Ministry of Food.

R. Rae, Director, National Agricultural Advisory Service, Ministry of Agriculture.

C.M.G.

A. de K. Frampton, Agricultural Advisor to Comptroller of Development and Welfare, West Indies.

S. Gillett, Chairman and General Manager, Overseas Food Corporation.

C.B.E.

B. T. P. Barker, Emeritus Professor of Agricultural Biology, Bristol University.

J. R. Bickersteth, Chairman, East Sussex Agricultural Executive Committee.

H. E. Blyde, for services to Agriculture in New Zealand.

R. Boutflour, Principal, Royal Agricultural College, Cirencester.

W. I. Newnham, Chairman, Soil Conservation and River Control, New Zealand.

P. J. Rogers, lately general manager Nigeria Tobacco Co.

O.B.E.

W. G. Burgess, for services to Agriculture in Western Australia.

Alderman H. Coultman, Deputy Chairman Leicester Agricultural Committee.

J. R. Coupar, Chairman, Guild of Agricultural Journalists.

F. Hanley, University Reader in Faculty of Agriculture, Cambridge University.

Capt. A. Hodgson, Principal, Ministry of Agriculture.

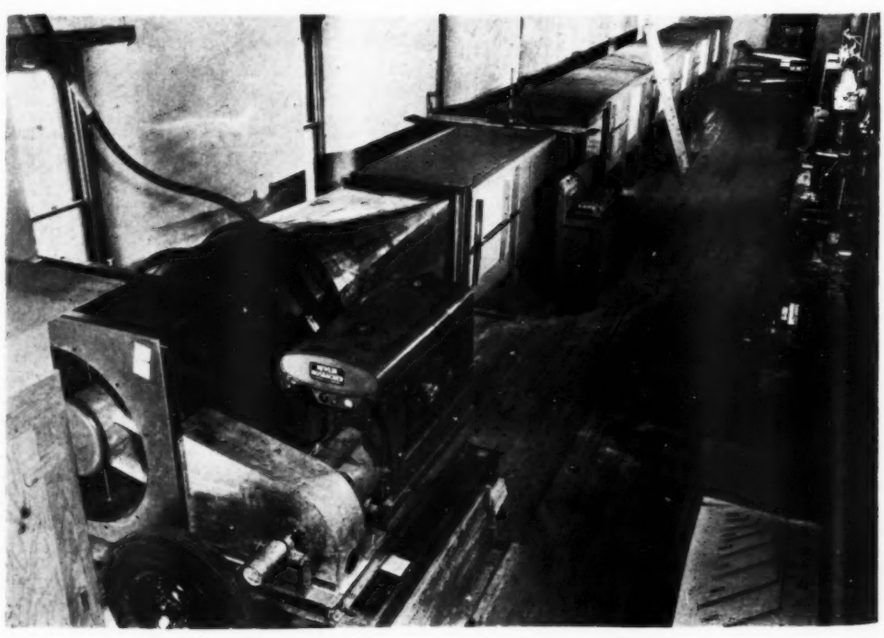
G. F. Porthouse, Principal Department of Agriculture for Scotland.

H. N. D. Wicks, a prominent horticulturist in South Australia.

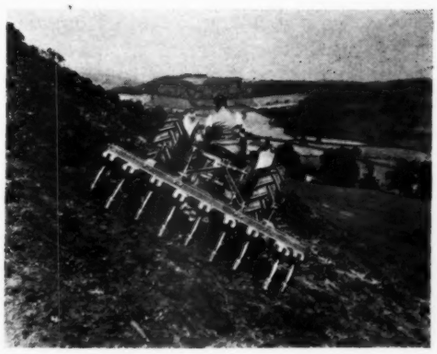
W. M. Williams, Land Commissioner, Ministry of Agriculture.

Wind Erosion Investigations

Wind erosion in drier continental areas is a problem of the utmost gravity. Large areas have been devastated as a result of it, one of the most spectacular examples being the notorious dust bowl in the central regions of the United States. Although satisfactory means of mitigating its effects are known and being extensively applied, much less is known about the physical factors which make soils particularly liable to wind erosion than is the case with sheet erosion caused by moving water. There is, however, research provision for investigating the matter at the Agronomy Department of Kansas State College. Studies in progress are stated to include the effect of winds of various strengths on different soil types and surface conditions, the wind force required to move particles of varying size and density, the effect of various applications to the soil on structure in relation to wind erosion resistance and the possibility of discovering materials which when applied to the soil will reduce soil movement.



General view of the wind erosion laboratory. The engine and fan create an artificial wind through the 56 ft. test chamber. The chamber is 3 ft. square with observation panels at intervals



Testing the New Fordson Major. (*Left to right*) **Rotary hoe equipment being tested under icy conditions, the new mounted cultivator in North Wales and hauling Cambridge gang rollers in Norfolk. The picture below shows tests in dust to verify the filter**

INDUSTRY'S CONTRIBUTION TO AGRICULTURAL RESEARCH—II

The Ford Motor Company

S. J. WRIGHT

Agricultural Adviser to the Ford Motor Co.

The evolution of new tractors and new and modified agricultural implements must obviously call for much research. This contribution in our new series deals with the work of the Ford Motor Company in this connection.

THE main plant of the Ford Motor Co. Ltd. is situated on the Thames at Dagenham in Essex, where over 16,000 workers are engaged in the manufacture of passenger cars, commercial vehicles and agricultural tractors. Implements for the tractors are made in a second factory at Leamington, which also turns out a great volume of steel castings for the Company's other products. Two further factories at Walthamstow and Langley are concerned mainly with replacement parts for earlier models.

The main plant at Dagenham is unique in the British motor industry, because it has its own blast furnace and coke ovens, and so is concerned with the whole range of manufacturing processes, from iron ore to finished vehicle. Coal, ore and other raw materials are brought by sea to the Company's own jetty alongside the factory, while vehicles and parts for export are loaded direct into sea-going vessels at the same point. The Dagenham plant started production in 1931.

The Fordson tractor

The Ford Motor Co.'s connection with agriculture is a very long one. The first Fordson tractor, which made its appearance in the United States in 1916, may indeed be regarded as the prototype of all the millions of farm tractors that are in use today, whatever their country of origin. It was far lighter than any other of its time, was the first to be powered by a high-speed multi-cylinder engine, and the first to embody the 'chassis-less' construction that has since become universal. Several thousands of these tractors were imported into Britain during the First World War, and played an outstanding part in the food production campaign with which the submarine menace of 1917 was countered. With them came the first self-lift ploughs ever to be used here.

This tractor, unchanged in external appearance, though greatly improved over the years in all its details, was destined to play an even greater part in the food production campaign of the Second World War. Manufacture had been transferred exclusively to Dagenham in 1933, and it was still the only farm tractor in large-scale production in Britain in 1939. In consequence something over 80% of all the new tractors brought into use during the war were Fordsons, and by the end of it they were well known on every size and type of farm.

It was with the replacement of this model by the Fordson Major in 1945 that the Ford Motor Co. first became actively concerned with farm implements. A new vogue for mounted implements had arisen, and the new tractor was equipped to make use of them; but the only way of making suitable implements available at that time was for the Company itself to embark on their design and manufacture. Since then, starting with ploughs and toolbars, an ever-widening range of equipment has been developed, either directly or in co-operation with some of the older established firms in the British agricultural engineering industry. Finally, this year, a completely new tractor—the New Fordson Major—and a completely new range of implements have been introduced.

Investigational work

Of all the investigational work carried out by the Company at Dagenham and elsewhere, by far the greater part is undertaken in the interests of manufacturing operations in general rather than of any particular product. Ford production methods demand the closest possible control of materials, finished components, and manufacturing processes; and from all that this involves a great variety of research problems are likely to arise. Moreover, because the broad objective of the work is to cheapen and improve quality over the Company's products as a whole, and because low cost and the ability to withstand rough usage are major requirements with all farm appliances, many of the results are of direct importance to agriculture in the long run. These activities must in any case be mentioned because it it mainly with the facilities provided originally for production control that research problems can be tackled whenever

they may arise. Prominent among these facilities is the main Dagenham laboratory, in which all materials are examined as a matter of routine. This is equipped with everything necessary for determining chemical and physical properties—of plastics, fabrics and paints, as well as metals and alloys—while a separate laboratory at Leamington deals similarly with the manufacturing materials used there. Also at Dagenham are four other control laboratories associated, respectively, with the blast furnace, the coke ovens, the foundry, and the power house. As examples of the wide range of problems that have been tackled and solved in recent years there may be mentioned the development of a malleable iron of high physical properties with a much shorter annealing cycle than is ordinarily required; the application of water cooling to foundry cupolas; and the perfection of a sintering process which enables fine ores—which, though readily obtainable, are normally unsuitable—to be used efficiently in the blast furnace. As it happens, another example, arising from one of the Company's lesser known activities, has a more definite agricultural outcome. As a by-product of the coke ovens over 25,000 tons of sulphate of ammonia are produced each year for use as fertiliser and, as a result of experimental work just concluded, a great improvement of quality has been effected.

Problems concerning tractors and implements

It is, however, with problems that concern tractors and farm implements directly, that we are mainly concerned here. These may roughly be divided into two classes according to the approach—engineering or agricultural—that they call for. In the first class would be included all that might arise in the design of the engine, hydraulic gear or, indeed, any of the internal mechanism of the tractor. The second class would include practically all problems arising in the development of farm implements, as well as those that are associated with the operation of the tractor as a farm power unit. Problems of the first kind demand the resources of the mechanical laboratory and the test bench; those of the second must nearly always be solved in the field.

The two departments undertaking this work are the Experimental and Test section of the Company's Design Engineering Division, and the Field Station. Just as the laboratories mentioned earlier exist primarily for the control of production, so the Experimental Department exists primarily for the control of design. But the physical requirements of the two kinds of work are much the same, and from the wide range of equipment available for testing engines and components almost any research rig can be provided as and when it is called for.

The Field Station

The Field Station is equipped with a variety of such appliances as dynamometers, loading cars and fuel meters; and has its own workshop in which special arrangements of these can be rigged up or modifications made to implements under trial. It also has a sufficient area of land for such trials as do not need special conditions or crops. But although fully equipped, the Field Station is, for the most part, no more than a headquarters from which field work is organised and controlled. The work itself must nearly always be done on actual farms, and must be widely spread over the whole country, and sometimes overseas, so that all necessary variations of soil and circumstance can be properly covered.

In relation to all the investigational work outlined above, one reservation ought, perhaps, to be made. All of it can properly be described as research, since it is concerned essentially with finding out what has not been known hitherto. At the same time, in almost every instance, the approach is narrower, and the final objective more limited, than would be the case in research work as it is ordinarily understood. This is particularly so where ever farm implements are concerned, for their design is very largely empirical and —in view of the wide gaps which still exist between plant biology and soil science, and between the latter and actual cultivation practices—is likely to remain so for a very long time to come. Another contributory factor is the ' commonisation ' of parts that is so constantly an aim in large-scale production. In the design of a tractor engine, for example, some regard will nearly always be paid to other potential applications—*e.g.* in commercial vehicles and industrial power units—nor is it at all unusual for farm implements and motor cars to have components in common. All this might be summed up by saying that agricultural engineers are less often concerned with evolving a perfect appliance than with manufacturing a saleable one; and that their investigational work must be directed accordingly.

Two recent examples

To illustrate both the considerations just mentioned and the general nature of agricultural engineering research, accounts of two recent investigations may be given. The first of these was concerned with the geometry of plough mountings and, being largely independent of immediate farming circumstances, could be carried out on what may be called research lines. The other, relating to the harvesting of root crops, was so intimately tied up with conditions of soil and crop, that only an approach by ' trial and error ' was possible.

The geometry of plough mountings

All the linkage systems used by different manufacturers of multi-furrow mounted ploughs can roughly be classified according to the way in which the working depth of the implement is adjusted and controlled. Perhaps the simplest method—though it is the least commonly used—is to arrange the linkage so that, subject to adjustment by a screw or lever, the plough is rigidly

The New Fordson Major with half-track equipment pulling a five-furrow Ransome disc plough

The dynamometer car, one of the pieces of test equipment at the Field Test Station

attached, so far as relative movements in a vertical plane are concerned. The main disadvantage is that depth is regulated in relation, not to the surface of the ground, but to the plane through the points of ground contact of the wheels of the tractor. The second method—and the one which the Ford Motor Co. has adopted so far—is to provide the plough with its own depth regulating wheel. Yet another is to provide a hydraulic control which aims at maintaining constant draught, and raises and lowers the plough accordingly. It is worth mentioning that experimental work carried out by the National Institute of Agricultural Engineering on these and other systems—in which the Company co-operated—had shown that the use of a regulating wheel on the plough was the best way of maintaining a constant depth of work on an irregular surface. There was, however, another factor to consider, namely, the contribution that the resultant weight of the plough might make to the adhesion of the tractor when it was at work. It was commonly assumed that in the absence of a depth wheel, and as a consequence of the ' suck ' of the plough, there would be a resultant downward force to be utilised to advantage. But of the magnitude of the force—and therefore of its ' worthwhileness '—nothing at all was known. To investigate this problem, dynamometers were built into two alternative plough mountings in such a way that all the reactions between tractor and plough could be measured; and research tests were carried out in a number of widely varying soils. The results showed that, as the depth of ploughing was increased from zero to the maximum that the linkages allowed, the effective weight of the plough fell off so rapidly that, at all ordinary working depths, the contribution to adhesion would be negligible however the plough might be mounted. So far as weight distribution was concerned, therefore, there was no reason to change the linkage already in production. It may be worth mentioning, however, that, as so often happens in this kind of work, the experiment did suggest an alternative linkage form which might have advantages of quite another kind; and on which more work may be done later.

Devising a potato harvester

The other investigation was much more typical of everyday agricultural engineering, being simply a matter of adapting a harvester, already in production for sugar beet and similar crops, for use on potatoes. Two main points needed modification: the shares with which the crop is actually lifted; and the mechanism which separates it from soil and puts it into rows for subsequent collection. Thanks to earlier work, published by the N.I.A.E., no great difficulty arose over the design of a suitable share; the separating mechanism, however, was more difficult. The existing mechanism was a spider rotating in a nearly horizontal plane, and if the aim of a dual-purpose implement was to be achieved, at least the principle of this must be retained. There were three factors that could be changed: the spacing of the fingers of the spider, its tilt, and the speed at which it rotated. At the same time there were innumerable field conditions which could alter: the nature and moisture content of the soil, including its stoniness; the nature and amount of haulm and weeds to be disposed of; the weight, size and variety of crop and so on. The ' user ' requirement was that all the crop should be lifted and put, undamaged and free of soil and debris, into compact rows. No more can be said of the experimental work, except that it involved trial after trial in field after field until, as the result of one minor modification after another, a satisfactory compromise between the requirements of two different crops, and of a wide enough variation in conditions to suit the majority of growers, had been reached.

Co-operation with official institutions

In both the above examples mention was made of related work carried out at the National Institute of Agricultural Engineering. From the earliest days, close co-operation with the Institute, and with its predecessor at Oxford, has been a feature of the Company's agricultural development work. Research tests of the old Fordson tractor were started at Oxford as long ago as 1931; and, during the following years, a great deal of joint work was done, notably on the problems arising from the introduction of pneumatic tyres. Again, more than a year before the outbreak of war—when it was recognised that the country would be faced, sooner or later, with an immense ploughing-up campaign in which Fordson tractors would inevitably play a very big part—experimental work on tractor utilisation in a wide variety of circumstances was started. More recently, equipment has been provided to assist basic research work on fertiliser placement and on plough stresses. The main purpose of this co-operation is to provide the wider, and more scientific, background against which the Company's own investigational work can be most effectively carried out. Similar co-operation has been established with research and educational institutions in Canada, Australia and Africa and, in the future, will almost certainly be extended.

Training scheme

Co-operation of another kind was first established when, in 1943, the Company seconded two specially selected young men to the Askham Bryan staff for a period of two years, so that they could gain first-hand knowledge of experimental work and research in agricultural engineering. Others were given similar training over the next four years and, in this way, the nucleus of the Company's own developmental staff was built up. These young men all came from the regular educational schemes through which special staff are recruited and trained: the trade school; the part-time scholarship scheme operated at the

South-East Essex Technical College; and the trainee scheme, in which selected men, many of them university graduates, are given special training in the works.

Conclusion

Mainly on account of the reservations made earlier regarding the scope of commercial investigations, very little of the work described is published in the ordinary way. Nearly always the end point of the work is a machine, and publication consists in making its application widely known. Largely for this purpose the Company maintains two permanent schools. One of these, at Dagenham, deals with the servicing and maintenance of tractors and implements; while the other, at Leamington, deals with their adjustment and use. Those attending are, for the most part, dealers' salesmen and mechanics; but special courses are regularly provided —for example, for advisory officers of the N.A.A.S. Another constant activity is that of mobile demonstration teams, which carry instruction right into the countryside both here and overseas; while, to back up all this, there is a regular outflow of sectional equipment, films, lecture notes and wall charts for local use wherever they may be required. Nor is this work to be regarded only, or even mainly, as sales propaganda, for agricultural machines reach fruition only in the field. Indeed, in their final evolution, the part played by farmers and farm workers is no less important than that of the research men, designers and production engineers, who are our main concern here.

It is a long way, in thought as in space, from a cupola in a foundry to a root harvester in a field. Yet a fair summary of all the investigational activities of the Ford Motor Company would be that it aims, all the time, at realising and utilising the connection.

Increasing Native Production in S. Rhodesia

If this season is favourable there is expected to be a very substantial increase in the output of grain and other produce from native reserves in Southern Rhodesia, reports the Public Relations Department. Reports from Native Commissioners all over Southern Rhodesia speak of the great enthusiasm with which African agriculturists are taking part in the food production drive. Never before, say these reports, has there been so much stumping of land, manuring and composting. In several districts 90% and more of the lands have been winter ploughed.

The Rome Conference

The main Conference Hall of the new FAO headquarters building, one of three rooms in this building with simultaneous interpretation equipment

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In our January issue we outlined some of the salient features of the earlier meetings of the sixth session of the FAO conference, held in Rome from November 19 to December 7. Below we give an account of the later sessions.

DURING the later stages of the conference interest centred particularly on the proceedings of the three commissions set up to deal with various aspects of the work of FAO. The commissions discussed the matters referred to them in great detail and finalised reports and resolutions which were afterwards presented to and adopted by the final plenary sessions.

Meantime, at other plenary sessions arrangements were approved for the administration of FAO during the period before the next full meeting in 1953. At certain sessions addresses were delivered by a number of eminent statesmen and other authorities from various countries.

Elections

At the plenary session held on November 27 Mr. Norris E. Dodd was reappointed Director-General of FAO for the ensuing term of two years. Numerous tributes were paid to the ability and energy with which he had discharged his difficult and arduous duties during his period of office, and great satisfaction was expressed, in particular, at the manner in which the transfer of the headquarters from Washington to Rome had been effected without unduly disrupting the work in progress.

The conference also elected Professor Josue de Castro as independent Chairman of the Council in succession to Lord Bruce, who, as already mentioned, has resigned his tenure of that office. Professor de Castro is Director of the Nutrition Laboratory of the University of Brazil and an acknowledged authority on nutritional questions.

Election of Council

The Council is the governing body of FAO during the period between the biennial full conferences. No elections were held last year because of the move from Washington. All six members whose term of office normally expired last year, *viz.* Brazil, Canada, Chile, Italy, South Africa and the U.S.A., were re-elected. Of the member countries whose term expired in 1951, Australia, France, Egypt and India were re-elected, while Cuba replaced Mexico and Finland replaced Denmark. Of the remainder whose term expires in 1952, Pakistan and the United Kingdom were re-elected, while the Netherlands, the

Dean Acheson in Rome, being greeted by Mr. Brannon, U.S. Secretary of Agriculture

(Left to right) **Signor Fanfani, Italian Minister of Agriculture; Signor Rebecchini, Mayor of Rome; Mr. Norris E. Dodd, Director General of FAO—at the Festival of Trees**

Philippines, Colombia and Spain replaced Burma, Belgium, Venezuela and Yugoslavia.

Addresses to plenary meetings

Among the addresses delivered to plenary sessions, that by Mr. Dean Acheson, U.S.A. Secretary of State, on November 29 was noteworthy. After congratulating FAO on the valuable work it was performing, he suggested that one of the most important tasks before the Organisation was that of providing standards of comparison for cultivators in different parts of the world. He considered, also, that it was in the field of agrarian reform that the democracies could most effectively grapple with the misleading slogans of Communism. The U.S.A. placed this matter foremost in the whole field of international relations.

The Canadian Foreign Minister, Mr. Lester B. Pearson, also addressed the conference on the same occasion and on behalf of his Government emphasised its belief in the important part which FAO is playing and its full support for FAO's programmes.

Pierre Martin, President of the International Federation of Agricultural Producers, addressed the conference on the subject of international commodity problems and emphasised that expanded agricultural production could only be achieved if it was accompanied by adequate guarantees which would ensure the orderly marketing of the increased production called for at equitable prices. He urged that the proposals for an International Commodity Clearing House should be revived through FAO's Committee on Commodity Problems.

On December 4 the conference was addressed by Dr. H. G. Bennett,* Administrator of the U.S.A. Point IV Plan, who pledged the full support of his organisation in FAO's struggle against hunger and want. He expressed his belief in the work of FAO and emphasised that adequate knowledge existed to enable the fight to be won.

Work of the Commissions

To facilitate their work the various commissions subdivided themselves into committees and panels to deal with particular aspects. These bodies submitted separate reports, which were considered at full meetings of the commissions and embodied into summarised reports for the plenary meetings of the conference. Some of the more important of the findings are summarised below.

* Since this account was written we greatly regret to observe that Dr. Bennett met his death in a recent airplane disaster.

Commission I

The field covered by this body embraced:

(1) **The current food and agriculture position in the world and its trends and prospects.**
(2) **The improvement of conditions for improving food and agricultural production.**
(3) **International commodity problems.**
(4) **Food shortages and famines.**

In their report under (1) they expressed concern that world food production is not keeping pace with population growth and that the expansion planned over the next two years, even if fully achieved, will be insufficient to remedy the situation. Special anxiety is felt over the outlook for cereals. Moreover, current demands for raw materials are tending to divert land and labour from food production and this may imperil the future. Although increased production depends ultimately on the farmer, responsibility for creating conditions in which farmers can and will expand production devolves on governments.

They recommended that all member countries should co-operate in preparing plans for expanding production by at least 1 to 2% per annum, and that these should be reviewed at FAO regional meetings in the spring of 1953.

Prospects for improvement

Under (2) the commission stressed the widening gap between what is known regarding the possibilities of increasing production and the primitive methods and techniques used by the great majority of cultivators. To close this gap governments should pay more attention to the establishment and development of extension and demonstration services. They resolved that all governments should be called upon to establish extension services brought down to the level of the men on the land, to provide adequate supplies and equipment for them, to undertake pilot schemes and to encourage the organisation of small farmers on a group basis. FAO should advise and assist in this whenever they are asked to do so.

Agrarian structure

There was general agreement that defects in agrarian structures, such as small and fragmented holdings, insecurity of tenure, lack of credit, unfair rentals and excessive taxation, seriously impede economic development. There was specific concurrence that concerted action was necessary to remedy these defects wherever they existed and that agrarian reform should be an important feature of FAO programmes in

The FAO Conference building, Terme di Caracalla, Rome

future. It was recommended that information should be assembled from all member countries on such questions and FAO should co-operate with them in appraising and organising reforms in the agrarian structure.

Credit and investment

In regard to credit and investment, it was agreed that governments which do not possess adequate institutions for providing credit for farmers, foresters and fishermen should assign a high priority for measures for establishing such facilities. On the international side FAO should encourage and strengthen co-operation with the International Bank for Reconstruction and Development, with other international institutions giving grants or credits, and with UNO in discussions of problems of financing economic development. FAO should organise training centres for the study, formulation and appraisal of development projects.

Migration and resettlement

The transfer, migration and resettlement of populations is often necessary, on the one hand, to relieve pressure in overpeopled regions and on the other to ensure the development of sparsely populated areas. In this the International Labour Organisation is primarily concerned, but FAO also has an important part to play. Co-operative arrangements between ILO and FAO in this regard already exist and these should be given full effect, while FAO should, on request, assist and advise member governments in carrying out specific land settlement projects.

International commodity problems

In regard to this (3), the conference considered the rapid alternation of fears of surpluses and fears of shortages to be a matter of grave concern. It was agreed that the existing machinery for dealing with commodity problems should be used more fully. Commodity control agreements as defined in the Charter could help to stabilise international markets. FAO was considered not to have played its full part in regard to commodity problems. Proposals were made for strengthening the work of the FAO Commodities Committee and the request made that the attention of the Economic and Social Council should be called to the views of FAO on this point.

Concerning particular commodities, it was agreed that those which were the subject of study by other inter-governmental bodies (*e.g.* cotton, rubber, sugar and wool) should be left to them, FAO being kept informed of progress. Regarding a number of others, the Commodities Committee should be asked to undertake rapid surveys in order to decide whether more detailed ones would be profitable.

Rice was a special matter and the continued shortage is giving cause for grave concern and requires urgent study. The Commodities Committee should undertake this task, having due regard to the position of the International Rice Commission. If it should appear that an international conference on the matter should be called, action should be taken without delay.

Food shortages and famines

In regard to this (4), it was considered that FAO should accept responsibility for detecting at the earliest moment impending food shortages and famines. It can only do this effectively if member governments keep it fully informed when these may be anticipated. Grave consequences can arise from serious food shortages in member countries and prompt action is needed before the emergency becomes critical, to prevent panic and to facilitate measures for food management and distribution.

It was recommended that in this connection FAO should explore ways and means of establishing an emergency world food reserve which could promptly be made available to member states threatened with famine.

Findings of Commission II

Commission II was concerned with questions relating to the detailed programmes of the work of FAO and proposals for their extension and further development. The various documents presented by the Director-General and the Council were examined in detail. Commendation was given to them all and their acceptance agreed to. The reorganisation effected during the past year was commended, also the work of the various technical officers on the staff.

The suggestion was made, however, that in future reports more details should be given of the way in which FAO funds had been expended. Some emphasis was laid on the need for decentralisation of effort.

International Plant Protection Convention

The final form of the Plant Protection Convention as adopted by the FAO-

sponsored conference in Rome in 1951 was approved. The convention provides for international rules covering the movement of plants in international traffic with a view to preventing the introduction of plant pests and diseases; it also provides for the issue of phytosanitary certificates. Each contracting country agrees to co-operate in a world reporting service on the occurrence of plant pests and diseases.

Locust control

The report of the Director-General on locust control and recommendations of FAO Council on the findings of the Locust Control Conference held in Rome in October 1951 were accepted and endorsed. They envisage the setting up of a regional Technical Advisory Committee on the control of the desert locust, while FAO, under the Director-General, will collect information and assist in co-ordinating national efforts in anti-locust campaigns.

The expanded technical assistance programme

The programme was examined in detail. It was suggested that pilot plant technique should receive special consideration, while technical assistance should be planned with due regard to the rate at which advances can be assimilated. Approval was expressed of FAO's accomplishments in this field.

Collection of information

Improvement was needed in the reports received from some member countries, while delays in transmission should be minimised. There is need for avoiding a multiplication of questionnaires and overlapping of enquiries. It was agreed that general reports should be supplied every two years and submitted in simplified form. Statistics should be related to suitable dates.

Publicity for the work of FAO

The Swiss delegation presented a statement in which they pointed out that the work of FAO was not receiving the attention its importance merited. They proposed that a document should be prepared and published outlining the objects and activities of FAO and the importance of agriculture in world economics. It should be distributed as widely as possible.

National FAO Committees

Emphasis was laid upon the importance of the work of FAO national committees. These are the main channel which provided a link between FAO and the official agricultural activities in the various countries. The hope was expressed that all countries which had not set up such committees should do so.

Commission III

This body was concerned with questions of administration and finance. The budget for the work of FAO for the ensuing two years was examined, modified and approved at $5,000,000. Subsequently, it appeared, however, that, in view of additions to programme proposals made by Commissions I and II, these sums would not suffice to cover the total expenditure envisaged. The matter was remitted for discussion by the full conference.

The commission also examined the basis of contributions by member nations and agreed to the raising of the maximum limit of individual contributions from 27.1% to 30% of the total.

Summary

The foregoing account provides an indication of some of the more important matters considered by the conference; it is impossible within the space available to do more than this. It is, however, evident that the gathering was one of more than ordinary importance and on its results the future of the organisation and, indeed, the whole future of food and agriculture in the world is bound in some measure to be dependent. Indebtedness is expressed to the Secretariat of FAO for making available material which has enabled this account to be compiled. The meeting is the subject of comment in our editorial columns.

Timely Venezuelan Boll-Weevil Campaign

At the end of 1949 the cotton boll weevil (*Anthonomus grandis* Boheman) was discovered for the first time in Venezuelan plantations. Moreover, it was found to be already at work on the plants in large numbers and at all stages of its life cycle; around Tocoron, just west of Caracas, the capital city, infestation had affected as many as 80%-90% of the buds. As urgent action was required, the Venezuelan Ministry of Agriculture called an emergency meeting in conjunction with the National Cotton Growers' Association. A permanent committee was set up to deal with the problem and an immediate campaign of control measures begun.

The basis of the campaign in the most infested areas was to eradicate wild cotton where it adjoined the cotton plantations and thus to starve the weevil pests during the period between harvest time and the new sowing season; that is, approximately February to June. In addition, chemical control of the weevil by aerial dusting and spraying was also imposed on all areas where 5% or more infestation had been reported; next, after the harvest, all plants were destroyed, and as a final safeguard all cotton seed to be used on uninfested plantations was fumigated.

Spraying wild cotton near Caracas

The Venezuelan Ministry of Agriculture, with full results of practical experiments on the cotton crop before them, placed a large order for a Shell product, Shell Weedkiller 20. To the latter was added a small quantity of '2, 4, 5-T,' a weedkiller of the hormone type, and the resultant spray became the front-line weapon of the campaign.

Getting the weedkiller to the scene of operations proved to be no simple matter. It had to be shipped from Cardon Refinery, about 125 miles along the coast to Borburata and thence by tank lorry some 60 miles over mountainous country to the scene of operations in the valley of Valencia. The actual application was from 250-lb. pressure pump fed from a 300-litre (approximately 70-gal.) tank mounted on each of a fleet of six jeeps.

In the first months of operation, January-March 1950, 200 tons of Weedkiller 20 were consumed; this figure was increased to 300 tons in a similar period of last year (when Shell also supplied Weedkiller 50, which is fortified with '2, 4, 5-T').

Taking into account also the associated aerial dusting and spraying programme, the success of the whole campaign has been so marked that all the most important cotton-growing areas of Venezuela (totalling some 42,500 acres) were covered before the third year (1952) of the original three-year plan.

Virus Decline Disease of Citrus

ADRIAN F. POSNETTE, B.A., A.I.C.T.A.
East Malling Research Station

In many parts of the world growers of citrus fruit have been much troubled by a disease which leads to the rapid death of trees and which has become known under the name of 'Quick Decline,' and in South America, 'Tristeza.' It has become established that the disease is yet another example of virus infection. The position is reviewed in the accompanying article by Mr. A. F. Posnette. He is a recognised authority on virus infections of crops and it was he who was originally responsible for the identification, as a virus malady, of Swollen Shoot which has caused such devastation of cocoa orchards in West Africa.

RECENT research on virus diseases of citrus in various parts of the world is gradually revealing a comprehensive picture from a jig-saw of isolated discoveries. The picture is already sufficiently clear for us to obtain a general view and we can see how several apparently contradictory facts cease to conflict with one another.

It now appears that a number of what were previously thought to be distinct diseases or abnormalities are caused by one and the same virus occurring as two or more strains, to which different species and varieties of citrus react differently. The chief complicating factor is the use of different rootstocks, citrus being grown on its own roots as seedlings, or grafted onto sour orange, trifoliate orange, rough lemon, grapefruit, the hybrid tangelos and other varieties. This results in two species, with quite different reactions to the virus, being grown together as a composite tree.

Africa, East Indies, Australia and the Americas

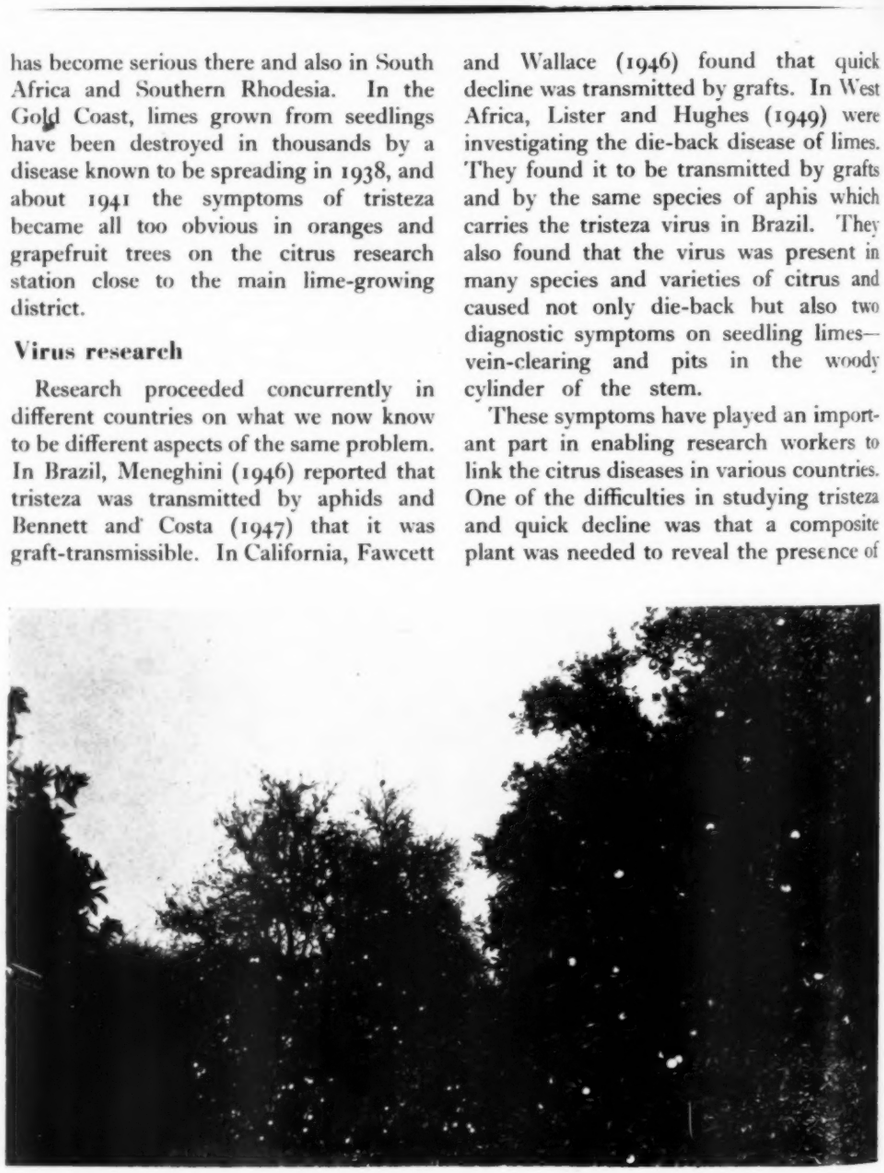
Before the presence of the virus was suspected, sour orange as a rootstock was known to be 'incompatible' with sweet orange, and many other types of citrus in South Africa and Java, where rough lemon and sweet orange are used as rootstocks; but in West Africa and in North and South America, this 'incompatibility' did not occur and sour orange was regarded as one of the best citrus rootstocks because of its resistance to soil fungi. This geographical influence on compatibility would certainly raise suspicion in these virus-conscious days! However, the sweet orange industry of Brazil, California and Florida was built mainly on sour orange roots, and all went well until 1937 when trees on sour orange roots were found dying in the State of Sao Paulo. Within 12 years, the disease called 'Tristeza' killed over six million trees in this State and had spread through the main citrus-growing areas of Brazil. The disease had previously been noticed in the Argentine and now affects most citrus areas in South America.

About 1939, a similar disease, named 'Quick Decline', appeared in California and continues to spread among trees on sour orange stocks in an alarming manner. In 1941, 'bud-union decline' attracted attention in Australia, and more recently a disease of grapefruit called 'stem-pitting' has become serious there and also in South Africa and Southern Rhodesia. In the Gold Coast, limes grown from seedlings have been destroyed in thousands by a disease known to be spreading in 1938, and about 1941 the symptoms of tristeza became all too obvious in oranges and grapefruit trees on the citrus research station close to the main lime-growing district.

Virus research

Research proceeded concurrently in different countries on what we now know to be different aspects of the same problem. In Brazil, Meneghini (1946) reported that tristeza was transmitted by aphids and Bennett and Costa (1947) that it was graft-transmissible. In California, Fawcett and Wallace (1946) found that quick decline was transmitted by grafts. In West Africa, Lister and Hughes (1949) were investigating the die-back disease of limes. They found it to be transmitted by grafts and by the same species of aphis which carries the tristeza virus in Brazil. They also found that the virus was present in many species and varieties of citrus and caused not only die-back but also two diagnostic symptoms on seedling limes—vein-clearing and pits in the woody cylinder of the stem.

These symptoms have played an important part in enabling research workers to link the citrus diseases in various countries. One of the difficulties in studying tristeza and quick decline was that a composite plant was needed to reveal the presence of



Valencia orange trees on sour stock. The tree on the left has declined so rapidly that many of the leaves have shrivelled on the tree

A row of Valencia orange trees showing two severely affected by quick decline

the virus. When sweet orange on sour stock is infected, symptoms soon develop which are recognisable by the experienced eye, but only after many months do the definite symptoms of chlorosis, defoliation and premature flowering become unmistakeable. Some test plant which could be grown easily and used when very young was required. Seedling limes proved to be the answer, for when infected with quick decline in California they quickly developed the same vein-clearing and stem-pitting symptoms noticed in the Gold Coast.

McLean, working in South Africa, found that the stem-pitting disease of grapefruit also caused vein-clearing and stem-pitting on lime seedlings. In Brazil, inoculation from oranges with tristeza to grapefruit caused the latter to develop the stem-pitting disease and so the identity of the diseases of limes in West Africa, grapefruit in South Africa and oranges in Brazil and California was established.

Symptoms

The symptoms of quick decline of sweet oranges on sour stock resemble those of trees which have been ring-barked. The foliage becomes chlorotic in a manner more suggestive of a mineral deficiency than of a virus disease, and there is progressive defoliation, followed by die-back of the smaller branches. When mature trees become infected, there is an ' incubation period ' of over a year, but once symptoms appear, they usually decline so rapidly that the fruit is left on the tree after the leaves have fallen. When young trees are infected, they flower and fruit prematurely. The internal symptoms are the most striking, however ; when the stem of an infected tree is split longitudinally, and stained with iodine, the accumulation of starch in the scion and its complete absence from the rootstock is demonstrated by an intense blue colouration which stops abruptly at the bud union. This starch accumulation is accompanied by (but not necessarily caused by) the death and blockage of phloem vessels in the bark of the rootstock near the union. Perhaps, as a result of this phloem necrosis, the feeding rootlets of infected trees die, and a feature of root excavations of severely affected trees is the virtual absence of fine roots.

There seems little doubt that the virus exerts its chief deleterious effects on the root system, and this is the reason why the rootstock plays such an important role in determining whether a particular stock scion combination is severely or mildly affected by the disease. It is not just a case of clear-cut resistance or susceptibility of different species, because whereas sour orange as a rootstock renders sweet orange as a scion susceptible, a sour orange tree on its own roots is scarcely affected at all, and neither is sweet orange on a lemon rootstock. It is the combination of a particular type of scion on a particular type of rootstock which must be considered as tolerant or sensitive.

Bennett and Costa, working in Brazil, have formulated an ingenious theory to explain why certain stock-scion combinations react as they do. As this explanation may have wider applications to ' incompatibility ' in other crops, it merits repetition. The theory starts from the premise that citrus varieties vary in the sensitivity of their phloem tissues to the virus and that they also vary independently in their virus concentrations. The sour orange, for instance, possesses very sensitive phloem, but only permits the virus to multiply to a low concentration, whereas the sweet orange has tolerant phloem and allows a high virus concentration. When sweet orange is grafted on sour orange stock, the high virus concentration in the former damages the phloem in the latter, but when the graft is reversed, the low virus concentration in the sour scion does not affect the tolerant phloem in the sweet stock. Other types of citrus differ in these respects. Grapefruit appears to be intermediate in both phloem sensitivity and virus concentration. Lemons seem to permit little virus multiplication and their phloem is highly tolerant ; consequently they make the most resistant rootstocks and also withstand the disease as scions on most stocks. Limes, on the contrary, permit high virus concentrations and have sensitive phloem, and so are susceptible, even as seedlings on their own roots. When different reciprocal combinations of many varieties of citrus were grafted, the results fitted this theory. For damage of the tristeza type to occur, the scion must be more tolerant and produce a higher concentration of virus than the rootstock.

Control measures

From what has been said, it is obvious that damage to sweet oranges by the tristeza virus can be avoided by using tolerant rootstocks, and rough lemon is the one in general use in countries where the ' incompatibility ' is endemic. Limes on rough lemon stocks are now being used in an attempt to resuscitate the lime

industry in the Gold Coast. When the virus invades mature trees of a susceptible combination, as is happening in Brazil and California, there are four possible courses of action :

1. To attempt, by inarching rough lemon seedlings, to change the trees over to a tolerant stock. This method has met with some success. When the bud-union is low enough, scion rooting can be encouraged by earthing-up.

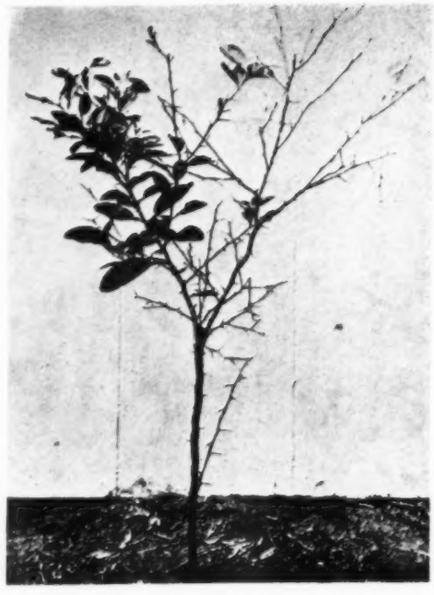
2. To attempt to eradicate the disease by destroying trees in the infected zone. Owing to the long incubation period, this would be practicable only if the disease were discovered soon after its introduction, while the zone of infection were still small.

3. To attempt to control the vector. This is much less likely to succeed than appears at first sight, because control in this sense would mean virtual eradication, not the reduction in the population usually adequate for commercial control of an insect pest.

4. To immunise the trees with a mild strain of the virus, if one can be found so mild that it causes little or no damage to sensitive stock-scion combinations. Once the virus has become established in tolerant varieties which show no symptoms eradication is impossible, and such a policy of immunisation would seem to provide the best means of saving the existing population of sensitive trees. The process of inoculation by bark grafting is simpler and more certain than that of inarching tolerant rootstocks, and whereas the latter process would lead eventually to all trees being infected with virulent virus, immunisation would mean that all sensitive trees would carry only the mild strain. This method is being studied in Brazil, where a mild strain has been discovered.

Where did the disease start?

It is interesting to speculate on the origin of this almost world-wide disease. As successful industries were built up with susceptible plants in Brazil, California and West Africa, it is evident that the virus has been introduced into these regions comparatively recently. The interchange of budwood, which has established such varieties as the Valencia and Washington Navel orange and the Marsh grapefruit in so many citrus-growing countries, provided an obvious means of dispersal, and the wide distribution of aphid vectors ensured rapid spread once the virus gained entry. The virus must have originated in one of the countries with a long tradition of incompatibility between sour orange stock and scion varieties—either in South Africa or the Far East. The weight of evidence at present gives the honour to South Africa,



Die-back of seedling lime caused by the virus in the Gold Coast

The vein-clearing symptom of the virus on limes in the Gold Coast

where a considerable amount of budwood has been distributed. It is significant, perhaps, that quick decline appeared in the Gold Coast soon after the importation of scion-wood from South Africa, but has not been reported from Nigeria, which has never, as far as the writer is aware, introduced citrus except from California and Florida. Although South Africa seems the most likely place from which the virus was introduced into South America and West Africa, it seems less probable that the virus travelled from South Africa to the many Eastern countries where it now occurs, than that it was introduced from the East Indies to South Africa in the early Dutch colonial years. The citrus industry in the Cape may have started with plant material brought from the Dutch East Indies in the 17th century.

Quick decline or tristeza appears to be absent from the Mediterranean and Pacific citrus-growing countries, and no doubt precautions are being taken to ensure that it is not introduced. The West Indies also seem to be free from this disease, although it seems possible that the decline in limes there is due to a similar virus. The writer has seen leaf symptoms in limes in Trinidad closely resembling those caused by the virus in the Gold Coast.

Conclusion

Enough has been said to show how the results of independent research fit together to build up a composite but essentially simple picture. Obviously, there are some gaps still to be filled in before the picture is complete, but the moral is clear. The danger of transferring viruses in symptomless plant material from one country to another cannot be over-emphasised.

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Christmas and New Year

Among the Christmas cards and calendars received this year were ones from the Caterpillar Tractor Co.; Dr. C. de Fellner, Alan Goodman, Esq., R. W. Gunson, Esq., Hercules Powder Co., D. P. Hopkins, Esq., Monsanto Chemicals Ltd., Pest Control Ltd., Scottish Mechanical Light Industries Ltd., Shell Chemicals Ltd., P. H. Southwell, Esq., and Universal Crop Protection Ltd.

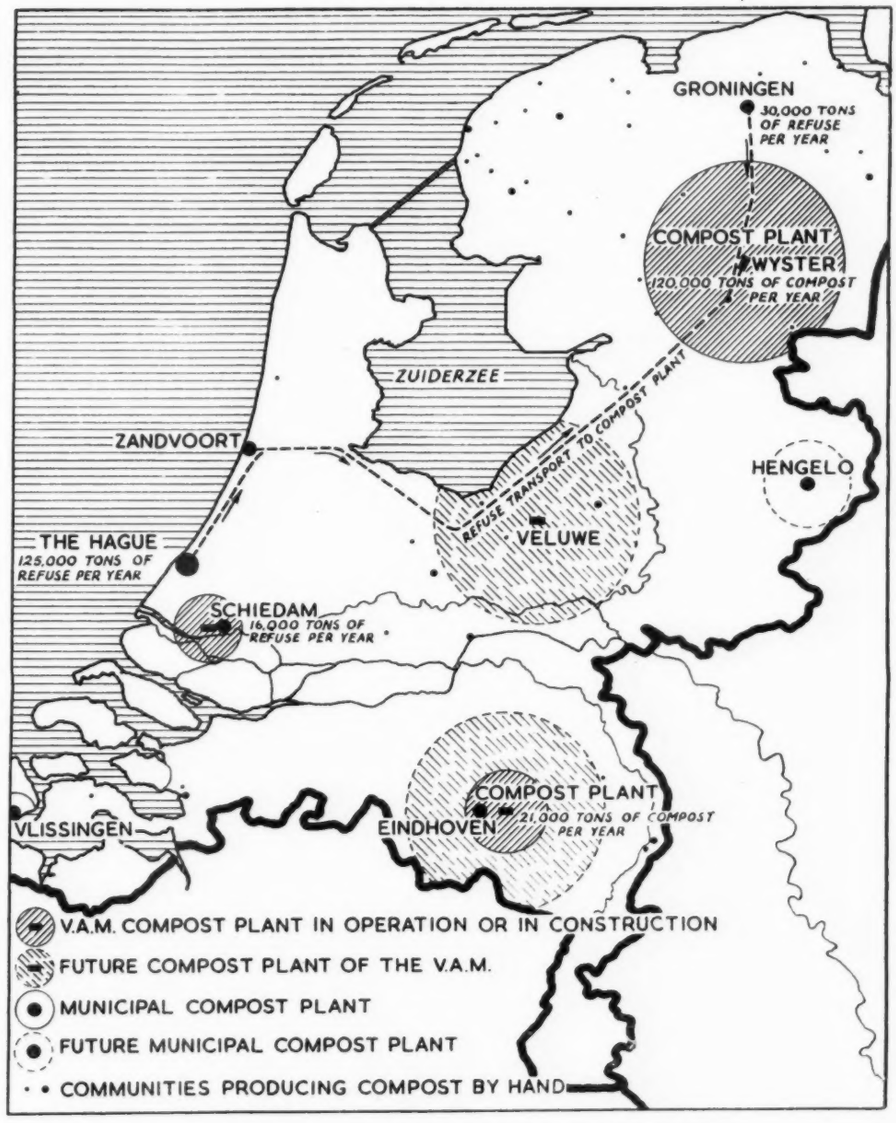
Soil Improvement from Town Refuse in the Netherlands

JOHN GRINDROD, B.A.(Com).

Expanding populations are making essential the utilisation of urban wastes in agriculture. In Holland, where population pressure is very great, rapid advances have been made of late years in composting town refuse.

UNDOUBTEDLY the largest and most enterprising undertaking of its kind in the world, the Dutch Refuse Disposal Co. Ltd., N.V. Vuilafvoer Maatschappij, V.A.M., is doing an excellent job in the Netherlands by turning town wastes into valuable compost.

The extent to which this is being achieved can be measured by the fact that each year, at present, some 150,000 tons of refuse are being converted into 120,000 tons of compost. The success of the scheme may be judged from the fact that the demand from agriculturists for the compost far exceeds supply and that large additional plants are on the way, not only for the V.A.M. but for municipalities themselves in many parts of Holland. Indeed, towns and cities all over the world are turning their attention to this urgent matter of refuse disposal while agriculturists in all countries are more and more appreciating the importance of compost in building up a satisfactory soil structure.



Scheme of compost plants in the Netherlands

The agricultural situation

In no country is the need for conserving and maintaining soil fertility more in evidence than in Holland. Although, historically, a country of farmers, Holland is now faced with an acute population problem. Whereas in 1900 her population was about 5 millions, today she has over 10 millions and it is still increasing by about 140,000 a year; this gives a density of 310 per sq. km. compared with 285 in England and Wales, 65 in Scotland and 76 in France. The intensive nature of her agriculture is illustrated by the fact that there is only 0.24 hectare (0.6 acre) of cultivated land per inhabitant, which is very small in comparison with other countries; thus in the U.S.A. there are 1.10 hectares (2.75 acres) per head of population. Moreover, the reserve of uncultivated land in Holland is practically exhausted and the Dutch are obliged to produce as much as possible from the land they possess.

Nowhere in the world is the produce per acre and the use of artificial fertilisers so great as in the Netherlands, and during the last 10 years, there has been a noticeable increase in the consumption of artificial fertilisers per hectare of cultivated land.

But there is a limit beyond which additional applications of artificial dressings cease to give greater output per acre, and indeed, this limit has already shown itself, especially on sandy soils, and also on some clay soils, which are beginning to show signs of exhaustion. Ever larger quantities of fertilisers have had to be used on these soils to obtain the same yield. The structure of the soil has deteriorated, having become either hard, in the case of clays, or granular where sandy, being easily blown away by strong winds. Crops have suffered quickly in drought and are less certain to be satisfactory; some, though well manured, have suffered because of the lack of certain trace elements.

All this has pointed to shortage of humus since, when the soil has been dressed with organic manure (stable manure or compost) the symptoms have usually disappeared and the crops have regained their vigour.

The Dutch have also sought to increase their agricultural output by reclamation work. In the last 25 years 175,000 acres of the former Zuider Zee have been dyked in and drained. In the next 50 years about 375,000 acres will follow. Also 700,000 acres of poor moorland soil have been found short of certain trace elements, notably copper and boron.

The functions of the V.A.M.

To the restoration of old, tired soils and to bringing into cultivation of new land, the compost produced by V.A.M. has made an important contribution.

V.A.M. is a semi-official company; its shares are held by the Dutch Government, and it was inaugurated in 1929. It was intended in the first place that the compost it produced should be used to raise the fertility of the poorer moorlands, but now the product is used almost entirely for existing tillage and grasslands.

Before 1900, the greater part of the Dutch town refuse, together with night soil, was sold to farmers as compost fertiliser, but when artificial manures came onto the market in large quantities, the demand dropped off and the compost became unsaleable. Dumping grounds and incinerators became the order of the day, although in some small places compost continued to be used as before. Intensive farming and more enlightened ideas later caused a complete swing of the pendulum and it is now realised that to ensure a good soil structure the regular use of organic manures is largely essential.

The process

The headquarters of V.A.M. are at Wyster, in the province of Drenthe; the material treated is handled on what is essentially a modified and wholly mechanised Baccari system.

The system is based on the following principles:

1. Manual labour must be avoided as much as possible, not only for hygienic and æsthetic reasons, but also to save expense.

2. The finished product must be cheap, as compost is a bulky material which is used in large quantities.

3. The business must be self-supporting, including payment of interest on capital, depreciation and the provision of reserves.

The income of the company is derived from three sources:

1. Payments from towns, the refuse of which is disposed.

2. The sale of compost, the price of which is now Dutch fls. 2.75 per ton (approx. 1.1 cu. m.) ex plant. The farmer himself pays transport by road or water to the farm and this averages out at D. fls. 3.00 per ton, bringing the total cost per ton delivered at the farm to D. fls. 5.75 or approximately 12s. in English money. (To permit transport by water a special canal 3 km. long has been dug to connect with an existing canal.)

3. The sale of residuary products, including iron, lead, aluminium, zinc, copper, bones.

Mode of operation

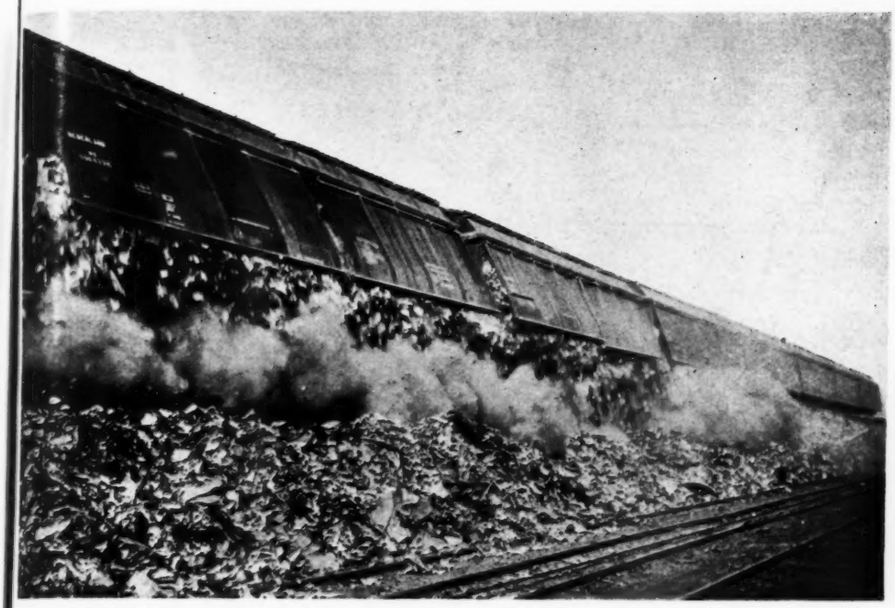
The plant at Wyster deals with the refuse of The Hague, Groningen and Zandvoort, representing about 700,000 inhabitants. Transport is effected by specially constructed trains whose wagons are completely closed until the sides are automatically opened for discharge, which takes place in 30 sec. The train, on arrival, draws up at one of four viaducts, six metres high and 475 metres long. When the train stops, the side valves of the wagons are opened automatically and the refuse drops on both sides of the wagon, which has a saddle-shaped bottom. The refuse is mechanically levelled and thoroughly sprinkled with bacilli-containing water. Twenty-four hours after sprinkling the temperature has risen to 60°-70° C. The next day another train-load is tipped and sprinkled and so on until the duct is filled up. The total accommodation at Wyster is sufficient to contain 120,000 tons of refuse. The Hague sends 125,000 tons a year, Groningen 30,000 tons and Zandvoort 3,000 tons. Fermentation takes from four to eight months (winter refuse four months; summer refuse eight months) and the plant works to capacity.

The refuse is dug out by travelling grab-cranes which tip it into a bunker and this automatically unloads its contents into lorries which are attached to an endless cable moving round the decomposing beds. The lorries take the refuse to the factory where it is unloaded by mechanical means.

In the factory the refuse is first put into vibrating screens where heavy materials such as bottles, broken crockery, bicycle tyres, mats, lino, etc., are screened out. The residue which passes through the meshes falls on a conveyor belt. Any article made of iron is drawn out magnetically and two men remove non-ferrous metals and bones. The remainder is pulverised in two big hammer-mills, the product being V.A.M. compost. In appearance it is 'earthy' and is almost free of odour. The capacity of the factory is 80 tons an hour.

Food wastes are never found in the refuse since such materials are collected at the house doors. Few bottles are found, since these are usually returned to the shopkeeper, while paper is often sold to the ragman. Investigations showed that in the winter of 1950-51 ordinary town refuse contained an average of 14% paper and 0.8% of rags and shoes. As no open fires

Loading a canal boat with town refuse compost at the Wyster plant of V.A.M.



A refuse train unloading at Wyster plant. The automatic discharge takes 30 sec., each wagon holding 33 tons

are used in Dutch homes, but closed stoves and central heating, the coal content is also relatively small.

The amounts of metals and inert materials contained in the raw material in 1950-51 were as follows:

		Tons
Iron, magnetically sorted	1.1%	1,650
Rubbish, bricks and bones	0.46%	690
Non-ferrous metals ..	0.30%	45

The following figures give information about the staff employed and the equipment:

No. of workmen	55
Of whom, technical staff ..	10
No. of wagons available for movement of fresh refuse	60
Weight of wagons	25 tons
Carrying capacity of wagons ..	35 ,,
Cubic capacity of wagons ..	100 cu. m.

Composition of the compost

The following figures show the approximate composition of the finished compost.

	%	
Organic matter (exclusive of non-combusted carbon particles)	4.5	–12
Nitrogen	0.4	– 0.5
Phosphoric acid	0.4	– 0.5
Potassium oxide		0.2
Calcium oxide (soluble in mineral acid)		3.0
Magnesium oxide (soluble in mineral acid)		0.3
Carbon dioxide		1.5
Moisture	25	–30
Loss on ignition	18	–25
Copper		0.04
Manganese		0.03
Boron	0.002–	0.005
Molybdenum		0.003

The compost also contains traces of other elements such as iodine, zinc, vanadium and chromium. The potassium, calcium and magnesium are 100% soluble and therefore fully active.

The useful organic matter content of V.A.M. compost cannot be judged from the loss on ignition because this gives too high a figure as a result of the unburnt coal particles from the ashes of house fuel. The organic matter content varies as a result of the seasonally changing composition of the town refuse, which, in summer contains 50% to 60% of fermentable organic material and, in winter, about 20%.

Rate of application

The usual dressing of compost is 50 tons per hectare (20 tons per acre) every four or five years. This is reckoned sufficient to keep the soil in good physical condition and the plant at Wyster produces sufficient compost to keep an area of 30,000 acres in good heart.

Effect of compost dressings

One of the effects of dressing of the compost is to increase the water holding capacity of the soil. Test plots on sandy soils which have received a dressing of 100 tons compost per hectare have shown increased moisture content of 4% to 5%.

The presence of appreciable traces of copper in the compost is considered to be very beneficial, since the absence of it causes ' reclamation disease.' A dressing of 50 tons of compost per hectare supplies enough copper to put this right. The presence of boron in the compost has also been proved to be helpful.

V.A.M. compost influences the growth of clover in a remarkable way. So far the explanation has not been forthcoming, but many farmers in Drenthe use it to stimulate a good stubble-clover crop.

Further developments

Following the success of this plant it has been decided to extend the production of refuse compost in the Netherlands, and V.A.M. is receiving additional capital amounting to D. fl. 10,000,000 from the Government out of Marshall aid funds to finance the establishment of new plants, which, of course, will have to be self-supporting.

Work has already been started on two factories where processing is to be done on a new principle, namely, at Schiedam (75,000 inhabitants) and at Flushing (25,000 inhabitants). In these the moistened fresh refuse will be pulverised by arms rotating over an iron plate perforated with 20 mm. holes and provided with sharp welded points after the style of a grater. The material that falls through the holes can either be used in a fresh condition as a heating manure by market gardeners, or it can be fermented into compost in stacks or moulds. This system is regarded as specially suitable for medium-sized towns with populations not exceeding 100,000, but the working results are, of course, not yet known.

The City of Eindhoven (140,000 population) has also agreed to a proposal to process its refuse in a plant about 10 km. from the city. This will follow the Wyster pattern, but will be of somewhat modified design. It will be equipped so that it can be extended to deal with refuse from about 800,000 inhabitants.

The Government is also negotiating for the erection of a plant in the centre of Holland to deal with the refuse from one or more towns where the waste products of from 800,000 to 1,000,000 people can be processed.

V.A.M. will thus probably ultimately deal with the waste from about 2½ million people, *i.e.* about a quarter of the Dutch population. In addition, several municipalities are already running compost plants and others are planning to do so, although it is quite likely that V.A.M. will eventually market the product of all these plants as well as its own.

In conclusion, it should, perhaps, be once more emphasised that the use of compost in Holland is intended primarily to maintain the physical condition of the soil and not to act as a substitute for artificial manures. It is in fact a soil conditioner.

Roselle – A Second Jute Substitute

A. E. HAARER, F.L.S.

Articles have been published in WORLD CROPS *on Kenaf, the last one by the same author in our September issue. We now publish information concerning the Roselle, at present second in importance among vegetable jute substitutes.*

WHY has Kenaf, and not Roselle, been chosen as the most important jute substitute by both American and British authorities? Roselle, *Hibiscus Sabdariffa L.*, is closely related to it botanically and in the heyday of the East Indies the Dutch preferred it to Kenaf, and continued growing it in spite of its susceptibility to *Phytophthora* foot-rot diseases. They tried to transfer the natural resistance of Kenaf, *H. cannabinus*, to this disease to Roselle by specific crossing, even using colchicine to double the chromosome content of the nuclei of Kenaf (2n = 36) to align the number with those of Roselle (2n = 72) but without achieving fertile seed. They then advised growing Kenaf in patches of soil known to be infected with the disease.[1 2]

Has Roselle been given a fair trial in comparison with Kenaf? What are the peculiar requirements of the plant, if any, and on what is the evidence based which has caused Kenaf to be chosen as the most important jute substitute? The answer to the first question must definitely be in the negative.

Early history

Long before jute became important in the world these two species of Hibiscus were being grown under various names by the people of India more widely than jute, principally because they both succeeded in the drier areas and were not so exacting regarding their environments. Yarns made from the fibres were hand spun and handlooms were used for making cloth from both fibres, as indeed they still are, while fishing lines, nets, and such like things were considered more durable if they were made of the Hibiscus fibres.[3] When the continent was partitioned and the two separate Dominions came into being, India began at once to exhort her peoples to grow more Kenaf and Roselle to provide extra material for her spinning mills.[4]

Kenaf was of considerable importance before then, and under the name of Bimlipatam jute it had long been used by mills in Madras and exported to Britain in sufficient quantity to become well known in our home markets.

Many will claim that Bimlipatam jute is inferior to the best grades of jute; that is, however, mainly because the Indian crops are often allowed to seed before the stalk is cut for retting, so that the fibre is harsher and less flexible. Moreover, the retting and methods of preparation leave much to be desired, and most of the analyses and reports of the past have dealt with samples of fibre prepared in a primitive manner by semi-literate peasants. When the stalk is cut at the proper time, and retted by modern methods, the resultant fibre is altogether a different product, and potentially competitive with the better grades of jute.

Varieties

But what of Roselle? Why did this fibre not also become of commercial rather than of rural importance in India? The reason can be given at once. The wrong varieties were grown.

The Howards were the first to attempt the separation and selection of the Indian varieties of Roselle, but they dealt wholly with the edible type, which is usually envisaged when Roselle is mentioned even today.[3] It was not until much later and quite by chance that the taller and stronger inedible type appeared in India as a single specimen grown from a seed accidentally imported—it was thought—from Java[5] where the Dutch had already begun to grow it. This type is *H. Sabdariffa* var *altissima*. Varieties of it have been propagated in India since then, and cross-bred with the edible varieties to produce the so-called "New Hibiscus" and other forms which are of considerable promise. The potentialities of inter-varietal breeding and selection have not yet been fully explored.

Requirements

Very little is known in the Western Hemisphere regarding the requirements for the economic production and cultivation of this variety. In the recent Kenaf breeding programmes in Cuba several entries of edible Roselle varieties were made for comparison with Kenaf, but only one entry of the *altissima* variety was included.[6] Yields were always found to be less than those of Kenaf, and one test in particular appears to have caused Roselle to be discarded in favour of Kenaf by the American authorities. This test was made in Alabama to study the possible utilisation of these plants as commercial sources of fibre in time of national emergency; the maximum yields of mill-run fibre produced under their experimental conditions were as follows:—

Species	Yield in Lb. per Acre
Hibiscus cannabinus L. . .	3,103
H. Sabdariffa var *altissima*	2,791

It was stated, however, that the stalk of the Roselle could easily be decorticated and that it yielded a relatively clean fibre superior in strength to Kenaf.[7]

The point to be borne in mind, however, is that both crops were sown at the same spacing and harvested after an equal period of growth.

Characteristics

Inedible Roselle is known to grow 16 ft. tall, whereas Kenaf seldom grows taller than 8-10 ft. In Java it is said to require warm, humid conditions, and a rainfall double that necessary for Kenaf, *i.e.* 10 in. of rain per month during the growing period as against only 5 in. for Kenaf. Moreover, the growing period is 7-8 months as compared with only 4-5 months for Kenaf. It is obvious, therefore, that it is unfair in comparative tests to give this variety of Roselle the same spacing, the same period of growth, and the same environmental conditions as for Kenaf and then condemn it because it did not prosper to the same extent.

It would appear, therefore, that given a longer and wetter growing season, and warm humid conditions, Roselle might do better and give better returns than Kenaf.

Moreover, it seems likely that the optimum spacing would be 12 in. by 12 in., while the best for Kenaf is 8 in. by 8 in.

Undoubtedly Kenaf is more adaptable than Roselle; it appears to grow well on a wide variety of soils, and in areas where the rainfall is less and conditions less tropical. It would be unwise, therefore, to contest the view that Kenaf may be the best choice for most of the areas in which it is at present being grown, except, perhaps, in West Africa whence the *altissima* variety of Roselle originated, and where Kenaf has been chosen for trial in development schemes.

Photo-periodicity

In the early 1940's when *H. cannabinus* was first being tested in America it was misnamed and referred to mistakenly as *H. Sabdariffa*. Accordingly, care must be taken when reading the literature to make sure that this error is not perpetuated,[8 9] Thus Roselle was reported originally to be very sensitive to photo-periodicity, whereas it was discovered later that this refers to Kenaf and not to Roselle. Little is known in fact about the daylight responses of the *altissima* variety of the Roselle, and whether it is affected by moving it from one latitude to another. The danger of doing this with Kenaf is, of course, well known and this matter of daylight response should be clarified. *H. cannabinus* grows wild from north to south in Africa, but Roselle nowhere covers such a wide range of latitudes in its wild indigenous state. Edible Roselle has, of course, been transported to many countries and is an older crop in cultivation than Kenaf, but it has hitherto chiefly been grown for its fruit, and seldom for a proper length of stalk for fibre.

Quality

As far as the quality of the fibre is concerned there does not seem to be much difference between Kenaf and Roselle. If there is a fractional difference then Roselle may be favoured for its strength, its colour and its gloss. Both show the same awkward character of inflexibility in comparision with true jute. The ultimate fibres under the microscope appear to be almost indistinguishable, chemical analyses of old and primitively prepared samples showing how similar they are, if it is indeed fair to make comparisons of fibre prepared under varying conditions by peasant farmers.

Cultivation

So alike are the crops physically that they may be cultivated in the same way and treated mechanically in the same manner, especially if the upright, non-branching *altissima* forms of Roselle are grown rather than the branched and sometimes sprawling forms of the edible Roselle. Mechanical implements can be used in the same manner for sowing and harvesting both crops though the taller growth of Roselle may make mechanical harvesting a little more difficult. As for bark stripping, decortication, retting and scutching, there should be no difference in the treatment of the material from the two species.

Conclusion

In the light of the foregoing it seems legitimate to conclude that Roselle as an alternative for jute should be by no means neglected. In certain environments it may be better suited for this purpose than Kenaf. More information is undoubtedly wanted in order to dispel some uncertainties, notably in regard to spacing and growth periods, while the possibility of improving the fibre by inter-varietal hybridisation and selection should be explored through further research. It seems not impossible that work on the latter lines might enable the production of a finer and more flexible fibre from it.

	Kenaf (*H. cannabinus*)		Roselle (*H. Sabdariffa*)	Jute	
			Percentages		
	(1)	(2)	(3)	(4)	(5)
Moisture	12.5	10.1	8.9	12.0	9.6
Ash	1.3	2.0	1.1	1.0	0.8
(*a*) Hydrolysis loss	11.8	8.8	12.3	9.2	9.1
(*b*) Hydrolysis loss	15.1	13.7	17.8	14.3	13.1
Acid purification loss	1.0	2.5	1.5	2.6	—
Cellulose	75.4	74.8	73.9	76.4	77.7

(1) Indian commercial sample. (2) Madras. (4) Medium quality. (5) Fine.
(extracted from Imperial Institute Bulletins)

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A Sitka spruce in the arboretum at Bicton, South-East Devon. This tree, 145 ft. tall and with a girth of 15 ft. at breast-height, must be one of the largest of the species in Britain

Sitka Spruce in the United Kingdom

Sitka spruce is a native of the Pacific coast of North America; the name comes from Sitka Sound in Alaska, and Britain obtains most of her seed from the Queen Charlotte Islands. The species was not much used for forest planting until 1920, but it has for many years past been the British Forestry Commission's first favourite. In the last year for which figures are available, 34,777,000 Sitka spruce were planted in Britain's state forests, or nearly as many as the next three most approved species put together.

It recently ranked, and may still rank, as the heaviest cropper (producer of the largest volume of timber per acre) of any species grown in this country. At 50 years Class I Sitka has a mean height of 100 ft. and a volume of 9,350 cu. ft. per acre.

Sitka will tolerate a wide variety of inhospitable conditions provided that the rainfall exceeds some 35 in. a year. It is thus a tree for the western side of the country: in East Anglia and other dry regions the Scots and Corsican pines do better. Home-grown Sitka yields pit props and excellent pulpwood.

The finest Sitka ('aeroplane spruce') is imported timber, for slow growth in a rigorous climate is necessary to give the required strength.

Drying of Agricultural Products

I. BERKOVITCH

A complete session of a recent conference organised by the Institute of Fuel was devoted to the drying of agricultural products. Crops considered included grain, seeds, grass, seaweed, hops and vegetables. Introducing the session was a general paper by Mr. W. H. Cashmore, Director of the N.I.A.E., which was followed by detailed papers on various individual crops. Below, the salient points of these papers are described by our contributor.

THE most important consideration in the drying of agricultural products was recognised on all sides to be its quality. In this respect, the key requirements are given in table 1 below.

Choice of temperature, machine, air humidity and fuel are all subordinated to the over-riding requirements of maintenance of quality.

With one exception, all the agricultural driers referred to in the papers use heated or dried air as the heating medium. The exception is a conduction drier of the roller type used for mashed potatoes. Pre-dried air has been successfully used for grain drying, and contributors to the discussion suggested that its use could be increased with advantage.

In the majority of driers using heated air, the products of combustion of the fuel are mixed with the air. However, where there is a risk of contamination, air only is used. In timber seasoning, as it is necessary at certain stages to maintain a very high humidity in the kiln, steam injection is employed.

Individual crops

For drying grass four types of driers are in use. Tray machines are found in small-scale farms, where baled grass is the most convenient form of product. For medium- and large-scale operation conveyor machines are used, particularly where grain drying is to be carried out on the same machine. Pneumatic or drum driers are employed in large factory installations and especially where it is desired to dry a variety of different products. Several of the large factory machines embody both drum and pneumatic principles. Pneumatic machines are most suitable where materials of a non-homogeneous nature have to be dried, *e.g.* beet tops.

Grain and seeds may be dried in a number of types of drier which were described by J. Woodforde. Again, the choice depends partly on the scale of drying operations. Machines available are the continuous-flow type, the ventilated silo and the platform drier. If the moisture content of the incoming grain is over 20% ventilated silos cannot be used. The conveyor drier may also be used for drying grass, while a further type, namely the platform or sack drier, can be adapted to dry a wide range of products. Mr. Woodforde put in a plea for further operational research into the requirements of farmers to help to determine the most suitable size and type of machine.

The choice of the most suitable drier for vegetables depends largely on the type of product required. A. Barker and T. Thomas proposed that the continuous conveyor, rotary-drum or roller drier could be used for waste vegetables for animal feeding. For potato mash powder both rotary and pneumatic driers appear to be suitable, the latter being considered almost ideal.

In general, it seems that the development of agricultural driers has reached a stage where there is no difficulty in obtaining a satisfactory product, provided care is exercised in the choice of type of machine and also in some cases of the fuel.

Further progress in design will be in simplifying operations with, possibly, wider application of automatic control, improvements in ancillary apparatus and improvements in thermal efficiency. Meanwhile a number of new techniques are also being considered.

The dry air system has important advantages where the amount of moisture to be removed from the product is small and where the temperature of drying must be very low. Its best application in agriculture is in the drying of grain and seeds where the above conditions apply. On the other hand, where materials of high initial moisture content have to be dried, and where high temperatures can be employed, there is little advantage in pre-dried air.

Another new technique advocated was the use of radiant heat. Of course, in most air driers a proportion of the heat is transmitted to the goods by radiation from the walls of the drier, but special radiants have not found much use yet in agricultural drying. Messrs. Barker and Thomas, however, in a paper on vegetable drying, referred to promising results using a combination of radiant heat with convective and contact drying.

Improving thermal efficiency

There was great interest in the possibility of improvements in thermal efficiency. P. H. Bailey, discussing the question of higher temperatures, showed that the advantage of high inlet temperature is to some extent offset by the resulting high exhaust temperature. The advantage is still further reduced on account of the fact that high-temperature single-stage driers are necessarily para-flow and must exhaust at rather low relative humidity. Radiation losses are also likely to be greater in high-temperature machines. The theoretical efficiencies approaching those of high-temperature driers can be achieved at lower temperatures by recirculation. This principle is already employed with good effect in many grass driers. It has resulted in considerable improvements in efficiency of even simple tray driers. However, with some products, such as hops and flax, the

TABLE 1

Material	*Requirement*
Grain and seeds ..	Avoiding damage to germination quality
Grass	Avoiding loss of nutrients, particularly digestible protein, carotene and other vitamins
Hops	Preserving colour and aroma and avoiding mechanical damage and loss of resins. Also avoiding contamination, especially by arsenic
Flax	Avoiding mechanical damage and discoloration
Sugar-beet pulp ..	Maintaining highest nutrient value
Sugar-beet tops ..	Maintaining highest nutrient value, separating dirt
Timber	Avoiding splitting or cracking and obtaining even drying throughout the timber
Vegetables	Preservation of colour, taste and aroma

characteristics of the material debar its use.

Bailey drew attention to the high thermal efficiency obtainable by the system of counter-flow driers with inter-stage reheating, but suggested that it is difficult to combine it with direct heating. Driers with inter-stage reheating are already employed for drying sisal.

The same author also discussed exhaust-heat recovery by condensation. Machines of this type having specific heat consumptions of 600 and 1,000 to 1,100 B.Th.U. per lb. show capital costs of £5 to £10 per lb./hr. water removed respectively. In addition these machines use electrical energy, the cost of which in this country would outweigh the low specific consumption. Another drawback is the fouling of the heat-exchanger surfaces with dust.

Reference was made in the discussion in a previous session to the heat-pump drier, and further details of the application of this machine to the drying of agricultural products would be of interest.

Fuels

Merits and drawbacks of the various fuels available for agricultural driers were considered both in the papers and in discussion.

Electricity, the most expensive fuel, has the advantages of convenience, cleanliness, simple automatic control and high efficiency of utilisation. For air heating the cost of electrical current can in general only be justified for special applications. For instance, it is useful where little energy is needed, exact temperature control is essential, the plant must run for long periods with little attention, and where the value of the product is relatively high. For these reasons, electrically heated driers in agriculture are mainly confined to low-capacity grain driers.

Liquid fuel—the next in order of cost—is widely used for direct-fired driers on the score of convenience, labour saving, quick starting, absence of standby losses and good thermostatic control. Gas oil has been generally used in the past, but a number of grass-drying plants are now operating successfully on a cheaper grade of oil fuel. Gas oil is the fuel most generally used for grain-drying machines, and either gas oil or electricity for ventilated silos and platform driers.

Coal and coke have the advantage of providing the lowest cost per heat unit. Coke furnaces of the semi-producer type are widely used for small grass driers. For the larger machines, mechanical coal stokers with automatic temperature control are suitable. These reduce the labour required for removal of clinker, hopper filling and ash removal. For high-output machines operating continuously, such as sugar-beet-pulp driers, chain-grate stokers are used.

Waste products, if available in sufficient quantity, may form a cheap source of heat for drying. C. P. Sayles described a furnace specially designed by D.S.I.R. for burning flax shives. The fuel is burnt in a hopper-type furnace followed by a combustion chamber into which secondary and diluting air is admitted. To prevent sparks entering the drier, there is a large spark-arresting chamber followed by a cyclone. The efficiency of the furnace was stated to be 88%.

Research

Suggestions were made in the papers that further investigation is required on many problems.

For instance, in drying grain we need methods of assessment of farm requirements in relation to type and size of plant. A quick, accurate method for estimating moisture in milled samples containing over 20% moisture is also required. Grass drying could be improved by investigating the loss of vitamins under various conditions, and also the effect on quality of high wet-bulb temperature. The hop industry would benefit by researches on the possibilities of employing continuous driers also suitable for grain or other crops.

Other investigations suggested were the development of improved methods of harvesting sugar-beet tops to produce cleaner raw material. Similarly, the nature and value of the scalding process for vegetables could be looked into, and the causes of discoloration and occurrence of off-flavours.

Costs

Information on the vital subject of costs can be most usefully given in the following table 2 compiled from data given in the various individual papers:

TABLE 2

Drier	*Spec. consumption* B.Th.U./lb. *water*	*Thermal efficiency*, %	*Fuel used*	*Source*
Grain driers:				
Horizontal	3,790	27.7	Gas oil	Woodforde, Fig. 2
Vertical	3,480	30.2	Oil	,, Fig. 4
Mobile	2,350*	44.7†	T.V.O.	,, Fig. 6
Grain silo	717	146.5	Electricity	,, Fig. 8
Platform drier	2,300–2,900	36.2–45.7	Oil	,, Fig. 12
Grass:				
Simple tray	3,000	35	—	Bailey, 3.1.2
Complex tray‡	1,500–2,000	52.5–70	—	,, 3.1.3
Multi-stage with reheating	1,350	78	Electricity	do.
Conveyor with condenser	1,000–1,100	95.5–105	,,	Bailey, 3.1.4
Heat pump	600	175	,,	do.
Hops (direct-fired kiln)	2,780–3.580	29.4–37.8	Oil	Burgess, 5
Sugar-beet pulp (rotary drum)	Down to 1,500	Up to 70	Coal	Campbell McDonald, 4

* Amount gas oil/lb./gal. = 8.6 cal. val. = 165,000 B.Th.U./gal. (gross).
† Some heat to drier from engine exhaust.
‡ Also pneumatic driers.

Aldrin Successes

Recent advices show that Aldrin is proving extremely efficient in controlling locusts and grasshoppers. Wherever it has been used for this purpose results have been outstanding, even under the most adverse conditions of weather and terrain. In Canada in 1950 Aldrin established new records for effective and economic grasshopper control. Over 1,000,000 lb. have been used in the past two years for this purpose. In the U.S.A. during 1950 over 1,500,000 lb. were used on crop and rangelands; the authorities estimate that the crop savings due to its control of grasshoppers exceed $25 million.

In April 1951, 13 tons of Aldrin were flown to Persia at the request of the Persian Government to assist in the control of the desert locust, reported in our issue for July 1951. The results, according to W. Mabee, entomologist in the U.S.D.A. Office of Foreign Relations, have been striking; over 53,000 acres of crops having been saved in 18 different localities as the result of its application.

Apart from locust control it is reported to have been very efficacious against wasps, the 'sen' pest (a pentatomid) which is very troublesome in wheat, and against aphids and crickets in poppy fields.

Meat from the Hills of Britain

A number of articles have appeared in WORLD CROPS *on hill farming in various parts of the world. Below we reproduce a short report on the schemes for improving hill pastures in Britain. It has been supplied to us by the Ministry of Agriculture and is written by Mr. R. E. Ware, Director of the Ministry's Agricultural Land Service.*

Pioneer crop of oats being grown before reseeding on hill land in Radnorshire

THE programme for increased home food production has given Britain more milk, more grain and more potatoes than she produced before the war. Meat production, although rising, is still less than it was before the war—partly because of the severe setback received in the cruel winter of 1946-47—but chiefly because Britain has had to switch over her economy from a pre-war dependence on imported feeding stuffs to reliance on what her own farmers can grow. The rebuilding, side by side, of the livestock population and the means to support it is necessarily a gradual process and one to which every part of the farming industry has to contribute. The interdependence of her more fertile farming lands and the wilder and more barren areas with heavier rainfall is not always understood. The hill areas are the natural nursery of many of the hardy cattle which can be fattened for the market on the rich grass or fodder produced in the lowlands, and the home, too, of the hardy breeds of sheep which are the parent stock of many of the vigorous cross-breds which provide our lamb and mutton.

The problem

Unfortunately, the hill areas have recovered less quickly from the agricultural depression than have those areas in which arable crops could easily be produced. The farms are often remote and approached by lengths of road which have fallen into bad repair; the level of economy has left little margin for new capital expenditure when needed; the hard life and the absence of amenities have caused some to leave and have attracted few newcomers. Finally, those farmers whose chief income is, or should be, derived from the rearing of store cattle or store sheep (intermediate products sold to other farmers for ' finishing ') have not benefited from fixed prices and guaranteed markets in the same way as have farmers whose livelihood comes from finished products. There has, therefore, been a tendency to substitute dairying wherever possible for stock rearing, although many of the farms are not well equipped for dairying and may have difficulty in maintaining themselves in this branch of the industry in the future.

Development policy

The steps which have been taken to encourage hill farmers to persevere in their important contribution to home food production are not as well known as they deserve to be. First came the hill sheep subsidy designed to prevent deterioration of the position and to enable the farmer who was rearing certain types of hardy sheep to carry on. But for this the disastrous winter of 1946-47, with its heavy losses of livestock, would have forced many hill farmers out of business. The hill sheep subsidy is flexible, and varies as the prosperity of this side of the industry rises or falls. There was also the hill cattle subsidy, aimed at encouraging farmers to stock up the hills with cattle. Then came the Hill Farming Act of 1946 with its improvement grants designed to tackle the root of the problem. This Act was limited in its effect to the true ' hill ' farm—that is, the type of farm which normally carries mountain sheep. The farmer who was prepared to make an improvement scheme —a scheme, that is, for the all-round improvement of his farm—could receive half of what he spent back again as grant.

Improvement schemes

There are 23 different classes of improvement to land or buildings listed in the schedule to the Act, covering buildings, roads and cattle grids, sheep dips, drainage, farm house improvements, fencing, shelter belts, electricity and water supplies, reseeding and so on. The farmer can combine any of these into a scheme if the Ministry of Agriculture agree that it will permanently improve the farm as an efficient unit. Grants will not be given unless the scheme will put the farm into proper working order. Either landlord or tenant can get the grant. Usually they need to co-operate in a scheme. Neighbours can combine to promote a scheme which may include a water supply or a road which serves them both.

Progress

In the four and three-quarter years since the Act came into force, 4,000 schemes affecting nearly 4,800 holdings in England and Wales with an area of upwards of 1½ million acres, excluding common grazings, have been approved or are under consideration. That is on the true hill farms alone. Now, under the Livestock Rearing Act, 1951, the same scheme has been brought further down the hill. Improvement grants are available for another five years, not only, as before, for the true hill farms, but also for farms in upland areas which are on land suitably essentially for the rearing of store sheep or store cattle. Thousands of new landowners and farmers are therefore now in a position to take advantage of the

£1 for £1 grant. It is true that the preparation of a good scheme is a matter for no little thought and trouble, but the County Agricultural Executive Committees are there to advise anyone who is considering a scheme; and are always willing to help by saying if a farm is eligible and advising on the preparation of a scheme.

For farmers who are not eligible under the Livestock Rearing Act, assistance is sometimes available under the Marginal Production Scheme 'A,' which is a scheme to help occupiers with the regeneration of outlying pieces of 'marginal' land which might not be economic for them to recover without help. Here, also, Committees will give full information and advice.

Improvements under the Hill Farming and Livestock Rearing Acts will take time to complete, and it will be still longer before their full effect is felt in the growing flow of healthy young stock from the hills to the lowlands where improved grass and arable farming will enable the farms to take all and more than the hills can send.

But agriculture is a long-term process and, in the meanwhile, hope has revived in an essential section of the farming industry. With the tremendous variation in British soils and rainfall, one can never think of one part of the country as being more important agriculturally than another. All have their part to play in feeding the growing population and keeping down dollar spending.

WORLD CROPS

OUR NEXT ISSUE will contain an account of **Recent Strawberry Breeding in Scotland,** which has been carried out by the Strawberry Disease Investigation Unit at the West of Scotland Agriculture College. The work which has been done to combat disease is described and will be of particular interest to our soft-fruit growing readers. The final number of Mr. H. Ferguson's trilogy on the **Gezira Scheme in the Anglo-Egyptian Sudan** will appear in the March issue; also part II of Mr. H. A. Curtis' article, **Rainfall, Watershed and Streamflow.** The third article in the current series, **How Industry Aids Agricultural Research,** will feature the work of Messrs. **Bayer Agriculture Ltd.** Other articles, research developments, book reviews, machinery notes, world crop reports, etc., will also appear next month as usual.

Hill land in the Plinlimmon area of mid-Wales. In foreground reclamation work has started

Control of Corn Lodging

In experiments carried out at the Inter-American Institute of Agricultural Sciences the use of aldrin (compound 118) has given effective results in the control of corn root pests. This has lead to a practical control of corn lodging by direct aspersions of aldrin on the surface of the soil, at the base of the corn plants.

In different regions of the Americas farmers suffer considerable losses from the lodging of the corn plants. This phenomenon is attributed to the action of wind and rain. Nevertheless, it has been proven that this is due rather to the destruction of the root system of the plants caused by the attack of larvae of chrysomelids known by such local names as 'vasquitas,' 'escarabojos verdes' (green beetles), 'catarinites,' etc. Frequently these insects are observed in the adult stage feeding on the upper part of the plant.

When aldrin was applied to an experimental corn breeding field involving different genetic material, of a total of 10,080 hills only three fell over, 75 days after the treatment. On the other hand, 45% of the 1,276 untreated corn hills on the border on the plots lodged. One and a half pounds of aldrin were used for each 10,000 corn hills in a concentration of 0.15% wettable powder. In ten untreated plots (of two-month-old corn) an average of 60% of plant hills fell over, while not a single one of those treated with aldrin fell. The larvae of chrysomelids in treated fields had a mortality of 92%. Counts were made also on the mortality of the attendant ants, corn root aphids, corn root bug (*Cyrtomenus* sp.) and other pests infesting the root of this plant.

Wine from Cyrenaica

The possibility of reviving the wine industry of Libya, introduced by Italian colonists before the war, and of exporting wine has been recently examined by M. H. Wuilloud, a Swiss viticulture expert, who took part in the mission of the Food and Agriculture Organisation to Libya.

A considerable area of Cyrenaica and Tripoli was planted with vines and other fruit trees by the colonists, but during the war the Italian population was evacuated, and many of these vineyards are now being cared for by the local inhabitants, who have little knowledge of scientific viticulture. In spite of this, the vines, which were originally grafted on to American stock, have remained immune from phylloxera, and bear good-quality grapes from which heavy-bodied dark-red wines are obtained.

The FAO expert considered certain red wines produced in the Barce district to be superior to some wines at present exported from France, Italy and Algeria.

The problem of the Libyan wine industry is not only one of technical knowledge, but also of providing an adequate outlet for the vine products. Since Libya has no industries, it is not considered feasible to produce grape-juice or alcohol, both of which require expensive equipment. The grapes are not suitable for drying and, since they ripen at a time when external markets are overloaded with fruit of all kinds, they could not be exported. The wine produced from them is, however, potentially of sufficient quality to attract attention abroad, once it became known. The FAO expert has accordingly recommended that the Cyrenaican vineyards should be restored to full productivity.

RESEARCH DEVELOPMENTS

Two New Selective Weedkillers

PROMISING new chemicals with selective herbicidal properties have recently been described in Britain and the United States.

DNBP

The British development concerns DNBP or, in chemical terms, 2:4-dinitro-6-secondary butyl phenol. This substance is of the same class of chemicals as DNOC. Research and field experience since 1946 has shown that it is effective for controlling weeds in crops of peas. Briefly, DNBP is similar to DNOC (sometimes more powerful) in its weed-killing properties, but is much less toxic to the pea crop.

Weeds vary in susceptibility to DNBP. Charlock, white mustard, treacle mustard and hemp nettle are readily killed; bearbind, pennycress, wild radish and shepherd's purse are fairly well controlled. Groundsel, mayweeds, corn poppy, chickweed, fat-hen and goosefoot are not so easily killed and several other common weeds, including the annual nettle, are fairly resistant. The herbicidal action is considerably influenced by temperature. Below 55° F. the toxic effect is so reduced that spraying may become uneconomic; above 60° to 65° F. the normal rate of spraying must be reduced as the risk of crop damage is sharply increased. General experience indicates that peas should be 4 in. high when DNBP is sprayed and the rate (for the pure substance itself) should be 2 lb. per acre. Ideally, the air temperature should be 60° F. when spraying takes place.

Formulating DNBP has presented difficulties. It is itself only slightly soluble in water but its ammonium salt is sufficiently so to enable its use. So far in Britain, commercial development has been confined to the ammonium salt, but there is an indication that DNBP itself as a suspension in water may be sufficiently toxic to annual weeds and less so to peas. As a few pea varieties seem less resistant to DNBP's toxicity than others, formulation as a suspension might be preferable in such cases. For distribution DNBP is dissolved in organic solvents, the concentrate being finally diluted with water on the site. Low-volume spraying is ineffective as there is no translocation of DNBP within the plant; really good foliage cover must be secured and the dose per acre must be dissolved in some 80 to 100 gal. of water.

DNBP is toxic to animals and man; like DNOC it must be handled with great care and protective clothing must be worn. It may stain the crop slightly. Both these facts are disadvantages in comparison with a selective weedkiller of the growth-regulating type (*e.g.* MCPA to which peas are more resistant than many weeds); nevertheless, British results show that DNBP is about the most satisfactory selective weedkiller for peas so far available.

Crag herbicide 1

The new American weedkiller is 'Crag Herbicide 1,' or 2,4-dichlorophenoxyethyl sulphate. This substance is said to possess the remarkable property of killing weeds in the seed or germinating stage; in short, it is a pre-emergence weedkiller. It was developed at the Boyce Thompson Institute and has now passed through extensive field and farm scale tests. At rates of application that would be economic or practicable, this substance will not damage established weed plants, and is harmless to crop foliage.

It is not itself toxic to seeds. Seeds exposed to a solution of the substance in water have still germinated and produced healthy plants. But with the addition of soil, the seedling produced has such inhibited growth that it soon dies in a stunted condition. It is assumed, therefore, that some microbiological change occurs when the chemical is mixed with soil and the actual toxic effect is due to one or more of the products formed.

Application is made at a rate of 2 to 3 lb. per acre dissolved in 40 gal. of water, just before weeds are expected to emerge; several such applications may be made during the growing season. For richly organic soils rates of 5 to 6 lb. per acre are required.

Obviously such a weedkiller is well suited for weed control where established plants are being cropped, *e.g.* strawberry fields, asparagus beds, etc. Where the crop itself is an annual raised from seed, the crop seeds are resistant only if they are deeply sown. Large-scale successes so far achieved have been with sweet corn, sugar cane, onions, gladioli and the two crops mentioned above.

Weeds that are well controlled are chickweed, lamb's quarters, purslane, redroot and carpet-weed; also the annual grasses.

For many horticultural crops the unique properties of this substance would seem to make it by far the most promising pre-emergent herbicide yet developed.

D. P. HOPKINS

REFERENCES

(DNBP). H. A. Roberts and E. K. Woodward, *Journal Min. of Agric.*, 1951, **58**, 6, 268-273.
(Seed toxicant). T. P. Finn, *Agric. Chemicals*, 1951, **6**, 9, 53-55, etc.

Development of Coral Atolls

Two scientists who have spent six months investigating the ecology and economic development of coral atolls, including ways of producing more food for their inhabitants, returned in October from the Gilbert and Ellice Islands to the headquarters of the South Pacific Commission at Noumea, New Caledonia.

Their project is one of high priority in over 40 comprising the work programme of the South Pacific Commission in the fields of health, economic development and social development.

Generally the areas of arable land on atolls are small and the soil thin and deficient in minerals. There is also a lack of research facilities and trained personnel.

It is for these reasons that the South Pacific Commission last year undertook to assist in the promotion of the economic development of these islands. Following consultation with representatives of the Western Pacific High Commission, the Fiji Department of Agriculture and the Gilbert and Ellice Islands Administration, the Commission laid down certain lines of research that would provide for a programme of coconut palm improvement designed to increase yields and resistance to pests and disease; a food plant programme, including study of the breadfruit tree, the development of wet land taro, the introduction of bananas, the production of other foodstuffs, especially those requiring additional fertility such as sweet potatoes, vegetables and citrus fruits, the supplementary nutrition of pigs, the improvement of poultry in weight, egg-laying capacity and freedom from disease, the development of shell fisheries by planting trochus and pearl shell, and investigation into the possibilities of sponge cultivation, and a survey of handicrafts with a view to their development as a source of income.

Approved subsidiary investigations included the use of solar stills for the distillation of water from sea-water, and exploration of the possibilities for atolls of hydroponics, or the growing of food plants in water charged with chemicals.

NEW BOOKS

Management and Conservation

of Vegetation in Africa. Pp. 97, illustrated, No. 41 of the Commonwealth Bureau of Pastures and Field Crops, 1951. 10s. 6d.

This bulletin contains a symposium by authors who deal with seven only of the territories in Africa south of the Sahara. Readers who follow closely the literature on African agriculture will find that they have read much of the material before, in earlier publications by the same authors. The section on Forest Reservation in the Gold Coast, and Edwards' article on Kenya, are in fact only reprints (the latter with a few changes) of papers in the Proceedings of the Conference Africaine des Sols, 1948, and the Sudan is represented by an abstract of the Report of the Soil Conservation Committee of 1944. Nevertheless, much of the information included is sufficiently important to bear repetition, and it will be useful to students and field workers to have it collected in a handy volume.

If there is one theme running through all the contributions besides the universal degradation of African vegetation, it is that our ignorance of the scientific factors involved is still great. Most of the authors have in fact concentrated on describing the existing vegetation and the history of its misuse, rather than its management and conservation. This part of their task is very well accomplished with some excellent photographic illustrations which add much to the textual descriptions.

On the more positive side, the symposium is disappointing. The authors have not dealt with their different territories on any common plan, and the result is uneven. Burning is surely the most important form of management or mismanagement applied to natural vegetation in Africa, but only Professor Scott, in an outstandingly useful contribution on South Africa, gives any details on this aspect. Nothing is said by any author about the proper and improper use of goats, the vast population of which in Africa is such an important instrument of grassland management. Some attention is given to grass leys and rotational grazing; none to problems of paddocking, water supplies, or the application of fertilisers to grassland. Hardly any data are quoted from experimental work to support statements made. That is perhaps not the fault of the authors, but of the past neglect of a vital subject to which this bulletin may help to draw attention.

G.B.M.

Marx Against the Peasant

By David Mitrany. Pp. 348. George Weidenfeld & Nicolson Ltd., London, 1951. 25s.

In this well documented book Professor Mitrany penetrates deeply into one of the most important but hitherto somewhat neglected aspects of modern and social history. The agricultural revolution in the West has, of course, its counterpart in the social upheavals which have effected the agrarian situation in the iron curtain countries. In the West, technical advances have brought about enormous increases in agricultural yields; as a result, available supplies of agricultural products have increased to such an extent to have enabled the western countries in times of need to make substantial contributions to food supplies of other parts of the world, and simultaneously has brought prosperity and security to the farming communities.

In the East, on the other hand, revolutionary movements based on theories and ideologies have disrupted production nearly everywhere. Not only have the feudal land-owning classes been dispossessed, but as a result of the revolutions large numbers of smallholdings have been liquidated in a very short space of time. In these processes have been included many small farm units built up on the ruins of large estates. In the process the class of land-owning peasants have been transformed into unwilling members of the labour force on collective farms.

In this book these dark and confused chapters of social history are set out with great lucidity by the author. He then proceeds to discuss in masterly fashion the efforts of the Communist party to build up a new theory of socialist agriculture in harmony with the points set out in Marx's work. The author traces the various stages through which agricultural policy has passed in these processes, using at first the peasant as a tool. In achieving the first stage of these revolutionary targets and then subsequently crushing resistance and wielding fiercely resistant peasants into a sullen mass intended to toil year in and year out for the benefit of the industrial proletarian, which is considered to be the backbone of the Communist state.

Professor Mitrany is in his element when he describes the evolution of the various peasant parties and the agrarian movement in East Europe.

He paints a clear picture of the land reforms which, healthy though they may have been on the whole, from a social and political point of view had a dubious economic outlook. A fact which in his opinion is responsible for a large part of the failures is that the majority of the leading Soviet ideologists did not possess the slightest technical knowledge of farming and considered that agriculture could be organised exactly on the same lines as those dealing with raw materials in factories.

The conclusions drawn by the author are striking. He points out that the Communistic ideology was designed in the first place to meet the needs of the industrial working masses. Nevertheless, it could not gain a real foothold anywhere in the west and its victories, from those in Russia in 1917 to those in China in 1947, have been achieved simply by taking advantage of the social and economic disruptions which have followed two world wars, and the exploitation of a discontented peasantry by Communistic leaders for their own purposes. There have been, in fact, proletarian revolutions achieved without the proletariat.

It would be a colossal task for generations to come to combine effectively a peasant economy with the new large-scale tech-

New Publications

The following books, published recently, are available from the Book Department, WORLD CROPS, Leonard Hill Ltd., 17 Stratford Place, London, W.1.

Bibliography of Soil Science, Fertilisers and General Agronomy, 1947-50. Ed. G. V. Jacks. Pp. 535. Commonwealth Agriculture, 35s.

Cacao, Prospects of the Growing of, in the British Solomon Islands, with notes on Malaya, Ceylon and Java, by D. H. Urquart. Illustrated. Pp. 44. Cadbury Bros. Ltd., Bourneville, 5s.

The Daffodil, Its History, Varieties and Cultivation, by J. M. Jefferson Brown. Illustrated. Pp. 264. Faber 25s.

Farming System, by A. J. & F. H. Hosier. Illustrated. Pp. 256. C. Lockwood. 21s.

Food & Nutrition, by E. W. H. Cruickshank. Illustrated. Pp. 454. E. & S. Livingstone, 30s.

Management and Conservation of Vegetation in Africa. Ed. R. O. Whyte. Illustrated. Pp. 113. Commonwealth Agricultural Bureau. 10s. 6d.

Textile Laboratory Manual, by W. Garner. Pp. 588. National Trade Paper. 30s.

nical developments which it is the aim to make use of on the great farming units. If a real and satisfactory balance between the two could be achieved it might in the end result in producing more food for a hungry world.

On the other hand, the book is yet another warning that the real task confronting humanity is to convince farmers and peasants of every race and colour living in parts of the world which have not yet come under the direct menace of Communism, that future prosperity and security is not to be achieved through the medium of half-baked ideologists but by the application of modern technical and economic development of agriculture on their own lands and to give them the knowledge and the means to put them into practiee. C. de F.

Estate Forestry

By Sir William Ling Taylor. Pp. 200. Illustrated. Crosby Lockwood, London, 1951. 15s.

This book is practically a sequel to the author's *Forests and Forestry* and whereas in that book he pressed the value of forestry to the nation he now presses it on the landowner.

The author deals in a thoroughly practical way with what species to plant and how to do it and lays well-deserved emphasis on the tending and maintenance of woods.

Naturally he feels that he must convert the careless owner of derelict land and the despairing possessor of woodland devastated in the war, so planting, pure and simple, gets most attention as a means of regenerating or, perhaps more accurately, of refounding a forest.

Quite rightly the importance of making conifers occupy a large if not the largest space in British woodlands is repeatedly put forward. One may not like them but they are more vital to the economy of the country than the broadleaved species. In discussing the value of the latter, the author rather underrates that of the useful pioneer, the birch, though admittedly our strains cannot equal the Scandinavian.

What will strike some woodland owners as not fully convincing are the statements about the wholehearted co-operation with estate forestry on the part of the State forest authority. There exists an unfortunate suspicion of the State, not without some foundation in the past and it will take time to get rid of it from the mind of the landowner.

It is a book which ought to be read by the unconverted landowner while the converted and anyone at all interested in the use of the land will enjoy the sound commonsense of the author. W.A.R.

CORRESPONDENCE

The columns of WORLD CROPS are open to correspondence and the Editor welcomes letters from readers supplementing and commenting on articles or on other matters within our sphere. Limitations of space may necessitate the abridgement of letters.

Aerial Surveying

TO THE EDITOR

Sir,

The interesting article on 'Aerial Photography and Agricultural Development,' in the December number of WORLD CROPS, reminded me of a comprehensive application of aerial surveying which I saw in the Murrumbidgee Irrigation Area, New South Wales.

The whole irrigated area was covered by a detailed aerial survey, on a scale of 10 in. to the mile. For the study of individual farms, this was enlarged four times. Consequently, as I have it in my notes, ' Not merely every farm or field, but every fruit tree and line of vines in the district are now on record; their growth, health, etc., are approximately known and deterioration or improvement can be followed. Further, it is of great assistance to irrigation and agricultural office staffs for simple reference; when a farmer phones up about a problem, the man in the office can put his finger on the exact spot under discussion.' The data from the photographs were extended by ground survey, and worked out by Hollerith machines. (See Howard & McIntyre, C.S.I.R. Bull. No. 168, 1943.)

Yours faithfully,
H. L. RICHARDSON,
December 18, 1951.

12 Upper Belgrave Street,
London, S.W.1.

An Agricultural Aircraft

TO THE EDITOR

Sir,

I have been interested to read the numerous articles in the December issue of WORLD CROPS on aircraft in agriculture. I notice that all the aircraft referred to are existing types which have been modified for agricultural purposes. This makes me wonder if you know of the aircraft built by the Texas A. & M. College specifically for agricultural duties.

It is the first aircraft specifically designed to meet the needs of spraying, dusting, and distributing seeds and fertiliser. Its extreme manœuvrability at low speeds allows it safely to fly at very low altitudes at 60 to 90 m.p.h., and to clear hedges and make quick turns at the end of each bout. The cockpit is placed high up on the fuselage so that the pilot has a greater field of view than is possible with any other single-engined aircraft.

A 27 cu. ft. dust hopper is fitted immediately forward of the cockpit, and 150 gallon spray tanks are built into the wing centre section. Provision is also made in the outer wing sections for dust hoppers to investigate possible improvements in distribution.

Special consideration has also been given to the pilot's safety. To protect against possible contact with wires during low-altitude operations the undercarriage legs have knife edges, and tubular guides are fitted over the cockpit canopy.

The aircraft is an all-metal low-wing monoplane powered by a 200-h.p. Continental engine, with a span of 39 ft. 0 in., and length of 29 ft. 8 in. A load of 800 lb. may be carried when operating from small fields, and 1,200 lb. from larger fields. Forty-eight gallon fuel tank capacity allows a cruising range of 400 miles.

The machine has been developed specifically for research purposes, and, because of the U.S. defence programme, is not likely to be put into immediate production.

Yours faithfully,
A. W. GREEN.
December 27, 1951.

N.I.A.E. Hostel,
Wrest Park,
Silsoe.

Our Contemporaries

Below we list a selection of articles appearing in the February issues of some of our sister journals in the Leonard Hill Technical Group:

Food Manufacture: ' The Vitamins,' a progress article by F. A. Robinson.

Dairyman: ' Dairying in Central and South America.'

Manufacturing Chemist: ' The Manufacture of Dextran ' by W. G. Norris; Progress Reports on Economic Poisons.

Muckshifter and Public Works Digest: ' The Design and Construction of Claerwen Dam in Wales.'

Petroleum: ' An Oil Refinery in the Canaries.'

FARM MACHINERY

(Top picture) The new American-produced Farmall Super C at work with a disc plough. (Lower picture) Farmall tractor, produced by International Harvester at their Doncaster, England, works, planting corn on the No. 1 experimental farm, Boulaonane, Morocco

Rotary Hoes Subsidiary

We are informed that Rotary Hoes Ltd. have formed a new distributing company in the U.S.A. Registered as Howard Rotavator Company Incorporated, it has headquarters at 3916 South Hanover Street, Baltimore, Maryland, and with effect from December 1, 1951, has become responsible for the distribution of Howard Rotavators throughout the Eastern States of the U.S.A.

Rotary Hoes now have associate or subsidiary companies on both eastern and western coasts of the U.S.A., in South Africa, New Zealand and France.

Wolseley Price Increases

It has been announced by Messrs. Wolseley Sheep Shearing Machine Co. Ltd., that owing to the rise in labour and material costs, the following price increases in certain of their products have taken effect from January 1, 1952:—

	Increase on previous price
Electric Fencers and Accessories ..	10%
Sheep Shearing and Horse and Cattle Clipping Machines ..	7½%
Engines and Elevators	5%
Engine and Elevator Spares ..	15%

Third International Exhibition of Agricultural Machinery

Our Rome correspondent has sent us an account of the above exhibition which recently took place in Turin as part of the International Salon of Technical Trades.

Some 300 firms representing 12 countries (Austria, Belgium, Czechoslovakia, Denmark, France, Germany, Great Britain, Holland, Hungary, Italy, Switzerland and the U.S.A.) exhibited their machinery and equipment. Over 20 British firms were represented, including Messrs. Harry Ferguson Ltd., Ford Motor Co., Rotary Hoes Ltd. and the Turner Manufacturing Co.

A well-known Italian company, one of the pioneers of farm mechanisation in Italy, showed two tractors, 25- and 55-h.p. models, the latter suitable for industry work, land reclamation, muck shifting, etc. A small 12-h.p. model tractor attracted much interest, having a four-wheel drive, and claimed to be capable of climbing 45° gradients. Its length is 6½ ft. and it can carry a 5-ton weight and draw most implements.

During the exhibition demonstrations of machinery and equipment exhibited were carried out on land loaned for the purpose by the local authorities. A National Agricultural Engineering Experimental Centre, incidentally, is to be built on this 220-acre site.

The ground was divided into lots assigned to manufacturers for demonstration purposes. An observation bridge was erected to enable visitors to watch the operations in detail, *e.g.* ploughing, hoeing, fertilising, sowing, irrigation, well boring, trench digging, draining, etc.

Expanding Caterpillar Production

Caterpillar Tractor Co. announces an expansion programme that will include a new factory in York, Pennsylvania, extensive additions to the Joliet, Illinois, plant, and some improvements in the Peoria, Illinois, plant.

The York plant will be built on a site of approximately 180 acres just outside the city limits and will cover about 360,000 sq. ft. of floor area. About 1,000 persons will be employed.

Major additions to the Joliet plant will be a 230,000 sq. ft. extension to the present manufacturing building, a separate parts building covering 280,000 sq. ft., and an addition to the heating plant. Over 1,900 people are already employed at Joliet and this number will be increased to over 3,000 during the current year.

In announcing the programme, President L. B. Neumiller said it has been made necessary by continuing expansion in the demand for Caterpillar machines and parts. The major portion of the programme, he said, will be financed with a long-term loan of $35,000,000.

Mr. Neumiller emphasised that the demand for Caterpillar machines has been at a high level ever since the beginning of World War II and has been augmented and intensified during the past year by orders from the military and increased activity in defence-supporting industries.

He said the company has been unable to satisfy this augmented demand despite its post-war expansion programme at Peoria and Joliet, which provided for the construction of new buildings, the modernisation and rearrangement of all older facilities, the installation of many new machine tools and the introduction of many improved mechanical processes.

The Farmall Super C

A new McCormick International tractor, the Farmall Super C, with 17 improvements and 12% more engine power than the Farmall C which preceded it, has been announced by the International Harvester Export Co. of America.

Adapted for paraffin and distillate attachments that allow use of low-grade fuel in addition to petrol, the new machine's features include a larger bore valve-in-head engine, battery ignition starting, an 18 in. high leverage steering wheel, hydraulic shock-absorbing seat and strengthened chassis from front to rear. In addition, it is stated that the tractor's self-energising double-disc brakes and swinging drawbar enable it to negotiate turns easily.

Like the other Farmall tractors, the new Super C has a line of 25 McCormick International implements, all hydraulically controlled. These include direct-connected, forward-mounted and trailing equipment.

Tractor with 12 Gears

A Dordrecht, Holland, automotive firm, Het Dordtse Automobielbedrijf De Jong, has exhibited a tractor at a motor show there which has a twelve-ratio gearbox. Nine are forward gears and three reverse. The use of this number of gears is a technical advance for which the Dordrecht firm has obtained world rights. A special plant for the model is to be established at Dordrecht. The twelve-ratio gearbox enables the tractor to tackle any agricultural or industrial task, whereas the whole field could only be covered previously by a range of different machines.

In the Transvaal, less than four miles from where George Honeyball discovered Witwatersrand's first gold reef, Howard Rotavators are being used to recover gold from the old mine dumps. Put to this new industrial use the machine is equipped with a six h.p. single flywheel fan. The work is done by a specially bladed rotor with a working width of 20 in., the depth of work being adjustable in ½ in. stages to a maximum depth (in most soils) of 9 in.

The new doors for grain trucks of Canadian National Railways; the research engineer in charge of tests stands on the right

Economy in Grain Transport

New 'low loss' grain doors developed by Canadian National Railways offer a number of advantages to shippers. Apart from having longer lives, the doors practically eliminate grain loss during transit, having a maximum bulge under grain pressure of only ⅝ in., as compared to the standard door's deflection of as much as 4 in.

Unloading is easier due to the three paperboard panels in the lower frames, and it is only necessary to puncture the paperboard to relieve grain pressure. The flow can be regulated by the size of the puncture, allowing grain to be bagged direct from the car if desired. Insertion of new paperboard is all that is required to ready the door for use again.

Colonial Mechanisation

The Secretary of State for the Colonies, Mr. Oliver Lyttleton, has set up a Colonial Agricultural Machinery Advisory Committee, and already a meeting has been held. Among the members are Colonial Office officials, Ministry of Agriculture officials and experts on farm mechanisation. There are 23 members on the Committee.

The setting-up of a centre in Britain for the interchange of information between Colonial manufacturers and users and their counterparts in Britain is being considered by the Colonial Office.

The Committee is under the Chairmanship of Sir Geoffrey Clay, Agricultural Advisor to the Colonial Office. Other members include Mr. S. J. Wright (Ford Motor Co. Ltd.), A. B. Lees (Harry Ferguson Ltd.), G. B. W. Schofield (Ransomes, Sims and Jeffries Ltd.), Capt. E. N. Griffiths (Rotary Hoes Ltd.), H. J. Wright (B.A.M.M.E.X.), and W. H. Cashmore (N.I.A.E.).

WORLD CROP REPORTS

WORLD

The rubber situation. Since mid-1951, there has appeared a levelling off or even a downward tendency in the world natural rubber production. Considerable losses of production from estates in Malaya have taken place, workers having absented themselves because of insecurity. However, the urge to acquire and hold stocks both by Governments and others has strengthened against a background of unsettled political conditions. The price of natural rubber in Singapore advanced 10% between July and September. Meantime world consumption (and more particularly United States consumption) shows a steady displacement of natural rubber by synthetic rubber, as production of the latter expands.

Official plans are being developed for the plantation of 20 million rubber trees in South Bahia over the next five years and for a further million to be planted in the Amapa Territory. This might eventually lead to a quadrupling of Brazilian production. During World War II output increased to nearly 30,000 tons in 1944 but fell away again to scarcely 20,000 tons in 1950, representing little over 1% of world output in that year.

The sugar outlook. Total world production of sugar in 1951-52 is unlikely to be substantially different from last year's. There will, however, be considerable changes in production in the main regions. Production in Europe will be about 8.8 million tons, as compared with close on 9.3 million tons in 1950. Production in Latin America and in the Far East, however, will be substantially higher. Cuba is expected to harvest the largest crop since 1949—and perhaps even the largest on record. Estimates vary between 5.8 and 6.1 million tons. The outlook also appears favourable in the Dominican Republic, Mexico, Brazil and the British West Indies. In the Far East it seems that production in Taiwan will, as has been expected, be substantially higher than last year—and probably the largest crop since the end of the war. The outlook in Indonesia also appears to be more promising.

As the production forecast for Europe as a whole assumes that production in Eastern Europe will be about the same as last year, almost the whole of the reduction will be in Western Europe, which is a net importer of sugar. The dependence of Western European countries on sugar imports will, therefore, be increased. In Eastern Europe, while production continues to increase in Poland, Rumania and Bulgaria, indications point to a lower crop in Czechoslovakia. Production in Western European countries, with the exception of Germany, Austria, Italy and Spain, is likely to be lower.

Recent sales of Eastern Europe sugar suggest that some unsold 1950-51 sugar is still available in this region. Both Czechoslovakia and Poland, the two chief exporters, found it difficult to sell their 1951 production, as they requested prices much above those prevailing on the world market. Moreover, they sought to sell their sugar entirely on the basis of trade agreements. Recently sales have been reported—some against sterling. In October the German Federal Republic concluded deals with Poland for imports of close on 8,000 tons (refined), and with Hungary for imports of 7,000 tons (refined). It is possible that deals for imports of 20,000 to 25,000 tons of refined sugar from the Soviet zone of Germany will be discussed, as well as some imports from Czechoslovakia.

American estimate of 1951-52 world rice crop. Reuter's Agency reports that the U.S. Department of Agriculture, in a preliminary estimate of the world's rough rice crop in 1951-52 (August to July) has put the total at 337,387 million lb. This would compare with the 1950-51 yield of 339,644 million.

The North American output is put at 5,751 million lb. against 4,944 million in the previous season: Europe is expected to supply 3,403 million (2,918 million) and Asia 310,633 million (313,367 million). The yield in South American countries is forecast at 8,640 million lb., in Africa at 7,774 million and Oceania 261 million, against 8,328, 8,412 and 265 million lb. respectively. Russian production, not included in the above areas, is inferred at 895 million lb.

MEXICO

Cocoa crop nearly doubled. Last year's Mexican cocoa crop totalled 8,572,927 kilograms, obtained from 29,835 hectares, and sold for 36,251,952 pesos, the Mexican Secretariat of Agriculture reports. The value of the crop showed an 81.77% increase on last year's figures, while 34.25% more land was under cultivation.

New land in the south-eastern State of Chiapas will be placed under cocoa cultivation this year.

N.W. EUROPE

Increased flax area. North-West Europe has in recent post-war years accounted for between 40% and 50% of world production (excluding U.S.S.R.) and the bulk of world trade in flax. With cotton in short supply and prices of flax rising sharply early in the year, the area under flax in this region was greatly extended and harvests are larger in 1951. In aggregate, the expansion in area is about one-third, the largest proportional increase being in the Netherlands.

FLAX AREA IN NORTH-WEST EUROPE
(1,000 hectares)

	1950	1951	% *increase*
France	39.5	46.2	17
Belgium	24.2	35.0	45
Netherlands ..	17.8	30.4	70
U.K.	16.0	17.0	13
	97.5	128.6	32

U.S.A.

1952 crop targets. The U.S. Government has called upon farmers to increase production this year to 4% above last year's yields to meet the greatest needs the U.S. has ever faced.

Announcing planting targets for spring crops, the Acting Secretary of Agriculture, Mr. Clarence McCormick, urged growers to make a special effort to boost production of livestock feed grains so that a high level of production meat, milk and eggs might be maintained. The Department said it would be prepared to support producer prices of maize, cotton, wheat, rice, soya beans, wool, milk and butterfat at the maximum levels permitted by law. That level was 90% of parity. Mohair will be supported at 75% of parity as of the beginning of the marketing year. No supports are, however, promised for pigs (hogs), beef cattle, poultry, eggs and other perishable products.

If the targets are attained, planting will total about 377.8 million acres, compared with 374.6 million last year, and twice as much farm produce will go to the market as in 1935-39 average.

In the case of maize, the Government aims at a crop of at least 3,375 million bushels, nearly 375 million more than last year. Even if such a crop were produced, supplies would not be large enough, the Department said, to permit rebuilding of reserves.

Another big cotton crop is recommended. The planting target is set at 28,000,000 acres, compared with 29,510,000 acres planted last year and about 18,000,000 in 1950. By increasing acre yields, the Department said, farmers

would be able to produce 16,000,000 bales, compared with 15,771,000 last year.

Other production goals set are 1,360,000,000 bushels of oats, 200,000,000 bushels of barley, 38,000,000 bushels of flaxseed, 22,000,000 bushels of rye, 42,000,000 bags of rice, 98,000,000 tons of hay, 54,000,000 bushels of sweet potatoes, and 16,000,000 bags of dry beans.

FRANCE

Grain crop prospects. The French **wheat** crop is estimated at 7,065,000 metric tons from 3,501,000 hectares, the Ministry of Agriculture announces. This estimate, made on December 1, compared with the September 1 estimate of 7,028,000 metric tons. The area under wheat on December 1, 1950, was 3,596,000 hectares.

Hybrid **maize** is showing a considerably better yield than domestic maize, a yield of seven metric tons per hectare being exported from the main producing areas against a maximum domestic maize yield of 4.7 metric tons.

The area under **rye** is estimated at 25,000 hectares compared with 27,000 hectares on December 1, 1950, that of **barley** at 288,000 hectares compared with 257,000 hectares, and that of **oats** 542,000 hectares compared with 574,000 hectares.

The area sown to **colza** is estimated at 126,400 hectares.

The **rice** crop is not expected to amount to more than 60,000 metric tons this year. This is a reduction of 10,000 metric tons on previous estimates, caused by floods in producing areas.

SOUTH AFRICA

Drought affects Natal sugar. The Natal sugar industry has estimated production during the current season at 606,050 short tons, or about 80,000 short tons less than last season's record output of 685,798 short tons, reports our South African correspondent. The reduction does not reflect fully the severity of the drought experienced this season, as plantations have been considerably extended in the past few years.

With favourable weather, therefore, production could have been expected to show a substantial rise over the 1950-51 record, and the output would have been sufficient to provide supplies for the planned expansion of the Union's export trade. In order to compensate growers for losses and additional expenses incurred as a result of the drought, the retail price of sugar was recently raised, while allocations to certain sections of the food industry were curtailed because of current lower levels of production.

THE RHODESIAS

Sugar plantations in Zambesi Valley. As the first step towards meeting the sugar requirements of the Rhodesias 20,000 tons of sugar a year may be produced from cane plantations on either side of the Zambesi River. This is half the present consumption of the two territories. A statement issued by Mr. Stanley Cooke, joint managing director of the Rhodesia Sugar Refinery Ltd., says that the land selected lies in the Tonga Native Reserve of Northern Rhodesia. The Northern Rhodesia Government will finance the pilot scheme. If this is successful it will be developed into a full scheme operated by a new company in which the Northern Rhodesia Government will have a controlling interest. At the same time a first experimental area is being cleared and planted on the Southern Rhodesia Bank. A sugar factory has already been acquired and will be erected in due course. The cost of sugar produced should be well below that of imported sugars.

Large increase in Native cotton crop. In 1950 for the first time the Native-grown cotton crop exceeded the European crop. The acreage planted by European growers in 1949 was considerably more than that of 1948 and, taken with the large Native crop, the 1950 harvest was nearly two and a half times as much as that for 1949. Reports from 273 European growers indicated 7,551 acres planted, of which 1,161 were abandoned. The yield was 1,985,535 lb. of seed cotton which gave an average yield of 310.73 lb. an acre and an average return of £10 10s. 0d. an acre. In addition a further 529,850 lb. was received from 158 growers who rendered no acreage reports. This was worth £17,752. Taking these figures into consideration the report on the 1950 ginning season of the Cotton Research and Industry Board estimates that the total acreage harvested was about 8,094.

The report says that for the first time it is possible to give some figures about the acreage planted by Natives. These are based on reports from Land Development Officers in February to March, 1950, before the season opened. The acreage planted was 11,450, total production of seed cotton was 4,362,101 lb., and the total value of the Native crop was £156,650. After the Native cotton levy was deducted the money paid to growers was £125,696. The average return was £13 13s. 7d. an acre and the net average received by growers was £10 19s. 7d. The purposes of the Native cotton levy are to provide all the seed required and to pay all expenses connected with the buying of the crop in the Native areas and its transport to Gatooma. A third purpose of the levy is to make available to the Native Development Fund any balance left surplus, and this is then used for the improvement of general conditions in the Native reserves. Expenses in the 1950 season totalled £22,428, and £8,525 was passed to the development fund.

Indication of the success achieved by the introduction of buying Native-grown cotton for cash on the spot is given in a table of progress, as follows:

Season	*Seed Cotton lb.*
1941-42	188,498
1942-43	53,500
1943-44	25,570
1944-45	16,901
1945-46	13,509
1946-47	75,543
1947-48	259,111
1948-49	1,400,007
1949-50	4,362,101

(*From the Southern Rhodesia Newsletter.*)

TUNISIA

Optimistic olive oil forecast for 1951-52. Tunisia's 1951-52 olive oil production is expected to exceed by a sizeable margin average production during the past 10 years. In early October preliminary forecasts for edible oil ranged from 42,000 to 50,000 short tons, with some trade sources going as high as 55,000 tons. Olive foots oil is placed at around 5,000 tons. This volume would exceed the average production of the past decade, but would be far below the record 1949-50 output of 115,700 tons. Some 44,000 tons were produced in 1950-51. (*Foreign Crops and Markets.*)

GUATEMALA

Coffee production down. Guatemala's 1950-51 coffee crop was smaller than the 1949-50 crop. By the end of the third quarter of the 1950-51 marketing year exports had reached only 730,657 bags, as compared with 784,048 bags in the same period of 1949-50. However, it appears that the exports may be down only about 10% or, in terms of bags, 1950-51 exports may be close to 800,000 bags. (*Coffee Trade News.*)

ECUADOR

Coffee exports, 1951. Ecuador's 1950-51 coffee crop is unofficially estimated at 275,000 bags.

Exports of coffee from Ecuador in the second quarter of 1951 amounted to 37,844 bags. France displaced the United States as the principal purchaser of Ecuadoran coffee in the second quarter of 1951, taking 16,753 bags. The United States took 8,264 bags and Chile 6,501.